The FOUNDRY

Volume 52
Number 16

Published
Semimonthly

CLEVELAND, OHIO, AUGUST 15, 1924

Molds Large Iron Gear Cases

Detailed Description of Molding Practice Involved in the Production of These Large Shells in Which the Bulk Is Out of All Proportion to the Weight

BY PAT DWYER

FOR reasons considered sufficiently important, the chief engineer of a large industrial enterprise specified cast-iron gear cases instead of the usual sheet steel covers for a train of gears to be erected in his plant. The order involved eight large and four somewhat smaller castings and was filled by the Kilby Manufacturing Co., Cleveland. One of the larger castings is shown in Fig. 1 and the opposite side of one of the smaller castings is shown in Fig. 2. The general characteristics in both castings are the same and the same procedure was adopted in making the molds in individual pits provided for the purpose.

After considering several alternative methods in connection with the available rigging and flask equipment, a decision was reached to mold the entire pattern in the floor under a plain flat cope as shown respectively in Figs. 3 and 9. The casting measures 21 feet in length, 50 inches in width and 8 feet 10 inches in height, and for convenience of handling in the foundry and elsewhere the pattern was constructed in two parts with the parting extending vertically through the center. The halves were fastened to-

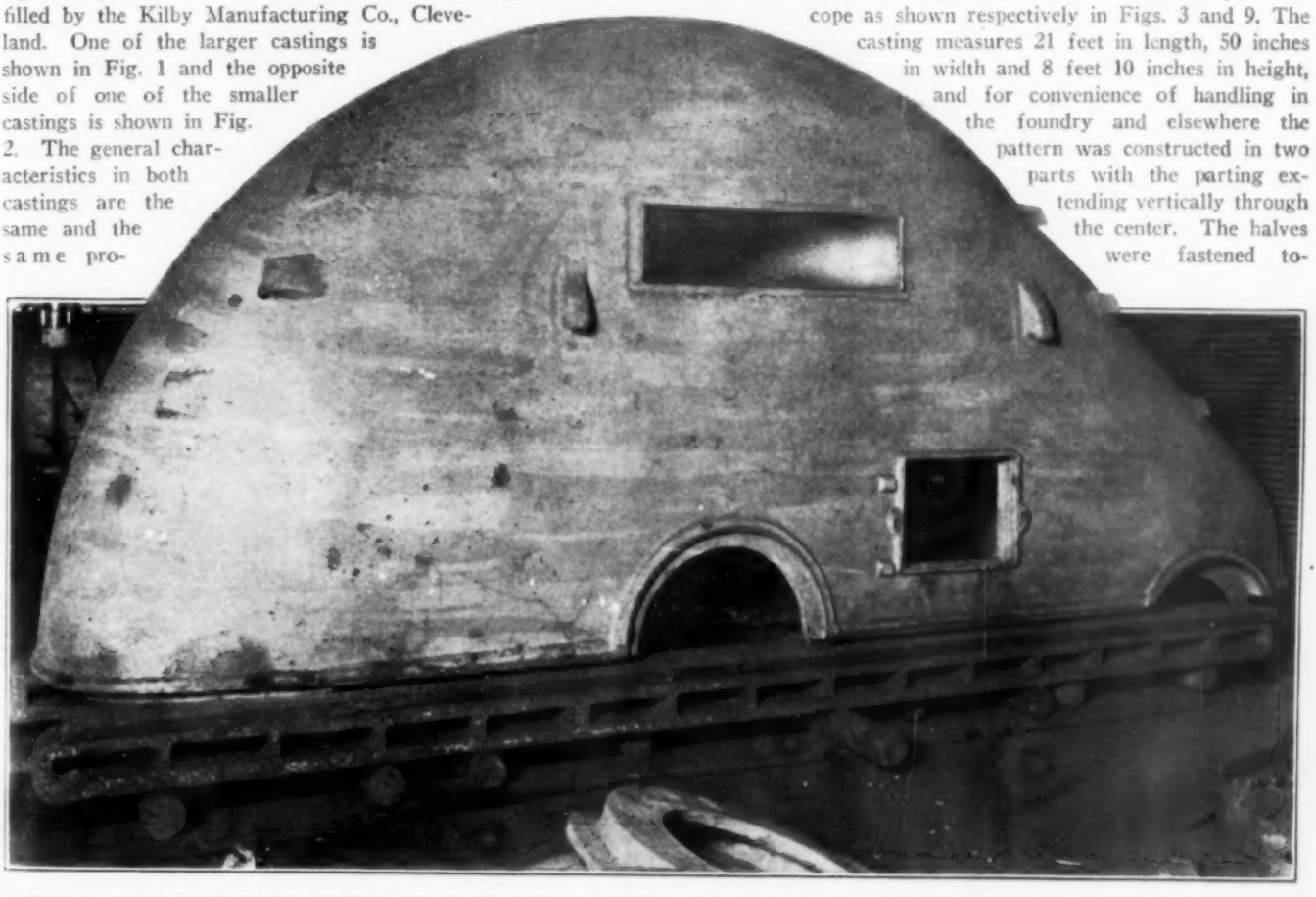


FIG. 1—CAST IRON GEAR GUARD AS IT APPEARED WHEN ROLLED ON SKIDS INTO THE MACHINE SHOP

FIG. 2.—INTERIOR OF THE SMALLER CASTING AS IT APPEARED AFTER THE LARGE CORES HAD BEEN REMOVED

gether temporarily until sufficiently surrounded by rammed sand to hold them in their proper position. The pattern was built after the manner usually employed on large patterns. A strong frame first was erected and the outside or sheathing was attached to the frame. This form of construction provides a pattern that is light, strong and contains a minimum amount of lumber. The various lugs and small openings on the sides were formed by attaching plain core prints to the sides of the main pattern and afterward placing suitable cores in the impressions left by the core prints. The ribs on the upper face of the casting, quite apparent in Fig. 2, were formed by cores made in the coreboxes shown in Fig. 4 and later attached to the cope.

To resist the enormous pressure exerted on the bottom, the sides of the mold and the cope, five, long, cast-iron binders were bedded across the bottom of the pit to serve as anchors for the long 2½-inch bolts employed in bolting the mold together before the iron was poured into it. Details of the binder construction and the manner in which the eye bolt engaged a short piece of 2½-inch cold rolled steel are shown in Fig. 7 .

The metal thickness in the walls of the casting was only 1 inch and therefore, the iron did not remain liquid in the mold for any great length of time, but for the brief period it remained in the liquid state it was essential that the mold should resist the pressure incident to the displacement of a body of iron equivalent to the volume of the core plus the extra pressure induced by a pouring basin almost 18 inches above the core. The core for the larger casting occupied approximately 452 cubic feet of space. One cubic foot of iron weighs 450 pounds. Therefore, it is apparent that the displacement of the core was equal to 100 tons of iron. The pouring basin was 18 inches above the cope face of the casting and this factor added a pressure equal to a mass of iron 1½ x 4 x 21 feet, in round numbers 30 tons. After deducting the weight of the combined cope and core, a strain of over 100 tons was distributed among the 10 long bolts, five to a side, designed to hold the cope in position. In other words, each bolt had to withstand a lifting strain exceeding 10 tons.

After the binder bolts were adjusted properly, sand was rammed between the binders. Iron plates were bedded down solidly for a foundation to support the mold. Iron standards in several sections were erected from the ends of the binders designed to terminate at the floor level and under the flange of the cope flask. This precaution was observed to prevent the walls of the mold from *crushing* from the combined weight of the cope and core, and also the pressure brought to bear on the

FIG. 3—COKE FIRED SALAMANDERS WERE EMPLOYED TO DRY THE DRAG PART OF THE MOLD IN THE FLOOR—THE IRON ENTERED THE MOLD THROUGH EIGHT GATES AT EACH END

cope while screwing down the bolts preparatory to pouring the iron into the mold. Steel wedges on top of the standards served to equalize any variation in height between them and insured close and intimate contact with the flange of the cope at the various points supported by the standards.

Sand was rammed in the bottom of the pit until the upper surface conformed approximately to the under surface of the pattern and at a height that allowed 1 or 2 inches of space between the sand and the pattern when the pattern was adjusted with the upper face flush with the floor level. This space later was rammed full of facing sand. The two half patterns were lowered into the pit and blocked up into an approximately correct position. Four long binders similar to that shown supporting the casting on the rollers in Fig. 1 were placed in position spanning the pit at equal distances apart. The two half patterns were drawn up and suspended by suitable hook bolts from the binder bars and were adjusted straight and level by wedges driven between the upper surface of the pattern and the lower edges of the bars. The blocking under the pattern then was removed and the space rammed full of facing sand. The binders, which also served as weights, were not removed until the sand surrounding the pattern had been rammed nearly to the top.

Eight, 1 x 4-inch gates distributed over each end as shown in Figs. 1 and 3 were provided to conduct the metal rapidly into the mold. It may be noted that the lowest gates are within about 3 feet of the lowest point on the mold and the succeeding gates are from 12 to 15 inches apart. Stumps from the lower gates may be noted on the casting in Fig. 1. The position of two of the upper gates and the pair next below may be noted at the far end of the mold shown

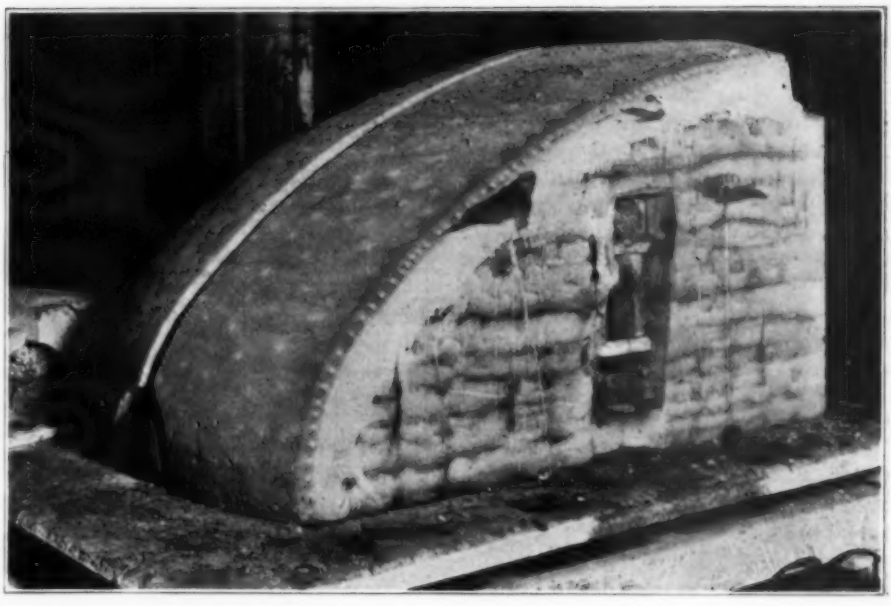


FIG. 4—LEFT—COREBOXES FOR THE UPPER FLANGE WERE PROVIDED WITH DETACHABLE PIECES TO FORM RIGHT AND LEFT CORES. FIG. 5—ABOVE—INTERIORS OF THE CORES WERE FILLED WITH COKE TO FACILITATE DRYING IN THE OVEN AND ALSO TO FORM A BODY THAT WOULD PRESENT A MINIMUM OF RESISTANCE TO THE CONTRACTION OF THE CASTING. FIG. 6—BELOW—END CORES WERE SPLIT IN THE CENTER AND RAMMED DIRECTLY ON PLATES ON THE CORE OVEN CARS—THE CURVED UPPER SURFACE WAS FORMED WITH A STRIKE TRAVELING ON SUITABLE GUIDE STRIPS

in Fig. 3. In passing it may be of interest to note that the gate stumps were left on the casting for the accommodation of the machine shop. On account of the peculiar rounded surface on the ends, sides and bottom, the casting presented a difficult problem in manipulation. The gate stumps gave a few convenient points for adjusting and attaching it to the face of the machine. Upright runner sticks, 2 inches square in cross section and of a suitable length were placed at each end in connection with the 1 x 4 inch horizontal gates. They were continued through the cope and the runner basin was formed in a manner that directed the first iron from the ladle into the runners leading to the lowest gates first and the others in gradual upward succession.

Contrary to usual practice, the cope was not rammed on top of the pattern. A flat parting was made flush with the upper surface of the pattern and then the pattern was drawn out of the sand.

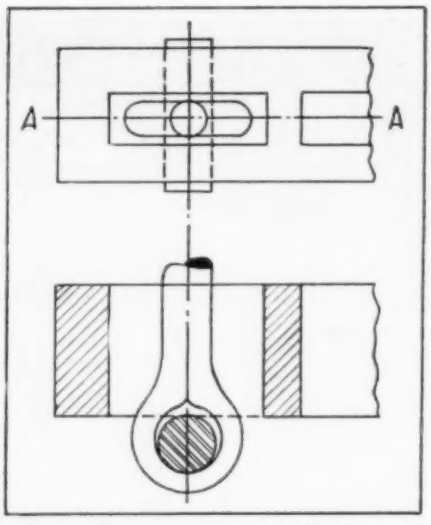


FIG. 7—UPPER, PLAN OF BINDER BAR AND BOLT—LOWER, SECTION OF SAME ON LINE *AA*

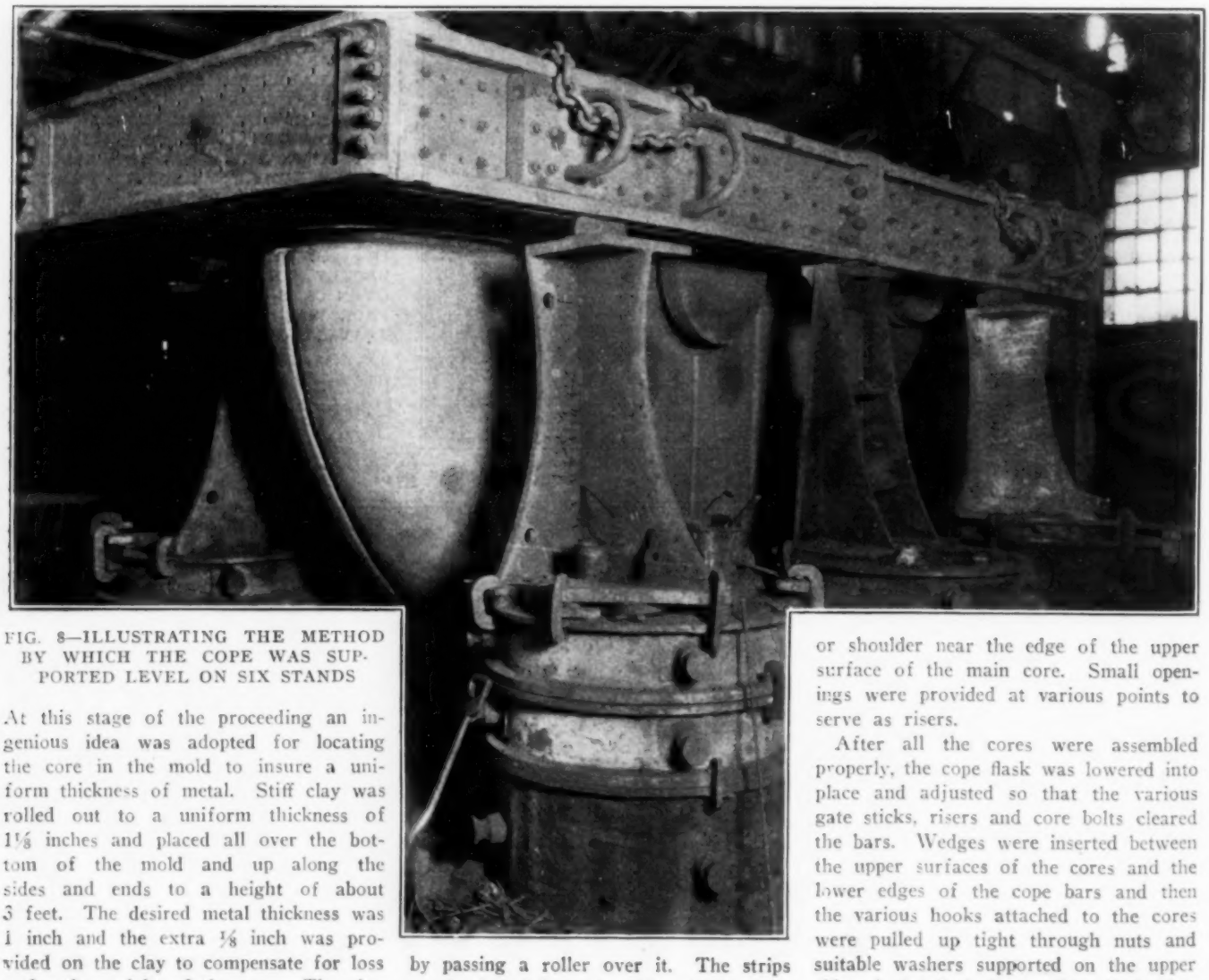


FIG. 8—ILLUSTRATING THE METHOD BY WHICH THE COPE WAS SUPPORTED LEVEL ON SIX STANDS

At this stage of the proceeding an ingenious idea was adopted for locating the core in the mold to insure a uniform thickness of metal. Stiff clay was rolled out to a uniform thickness of 1⅛ inches and placed all over the bottom of the mold and up along the sides and ends to a height of about 3 feet. The desired metal thickness was 1 inch and the extra ⅛ inch was provided on the clay to compensate for loss under the weight of the core. The clay was prepared on a planed board 2 feet in length, 1 foot wide, equipped with two guide strips 1 x 1⅛ inches spaced longitudinally 8 inches apart. The lump of clay was placed between the strips and flattened out to the desired thickness by passing a roller over it. The strips on the board kept the sides of the slabs straight and the ends were trimmed with a trowel and short straight edge. The slabs were laid in the bottom of the mold with adjoining edges touching with the result that a continuous clay surface was presented for the support of the core.

The sectional parts of the core were lowered into the mold and automatically adjusted themselves in their proper relative position on the supporting layer of clay on the bottom and sides of the mold. Short pieces of 1-inch board were inserted near the top edge between the core and the mold on both sides. The half round cores designed to form the shaft openings in the sides of the casting were placed in position by resting one end of the core in a print at the joint of the mold and the other end in a corresponding print in the main core.

The internal ribbed flange around the top of the casting, which may be noted in Fig. 2, was formed by a number of covering cores made in the coreboxes shown in Fig. 4. The cores were dried and then laid in position. They were guided into place by a suitable check or shoulder near the edge of the upper surface of the main core. Small openings were provided at various points to serve as risers.

After all the cores were assembled properly, the cope flask was lowered into place and adjusted so that the various gate sticks, risers and core bolts cleared the bars. Wedges were inserted between the upper surfaces of the cores and the lower edges of the cope bars and then the various hooks attached to the cores were pulled up tight through nuts and suitable washers supported on the upper side of the flask bars. The flask then was rammed full of sand, stakes were driven outside the corners to serve as guides and the chains on the crane were

adjusted to exert an even pull on the four double handles of the cope.

The cope with the various cores attached was lifted away from the mold and placed on the six, high stands provided for the purpose as shown in Figs. 8 and 9. The level position of the cope was maintained by lowering it slowly until the flange of the cope at one point came into contact with the highest of the six upright. The load was held stationary at that stage until the other uprights were extended by suitable iron blocks and wedges to meet the flange. Thus when the load was released from the crane it was supported adequately and in a perfectly level position. The chains by which it was lifted were left in position and therefore no adjustment was required later when the cope once more was lifted from the stands and lowered into position in the drag part of the mold.

Slabs of clay were removed from the bottom of the mold after the combined cope and core had been lifted out of the way. The face of the mold was finished. The horizontal gate sticks were drawn in and the edges of the gates were filleted and nailed. Face cores designed to form the lugs, also the openings in the side of the casting, were tucked into place and the face of the drag mold was blacked and slicked.

FIG. 10—EMERGENCY RIGGING EMPLOYED IN THE FOUNDRY FOR BINDING THE COREBOX AND PLATE TOGETHER BEFORE ROLLING THEM OVER PREPARATORY TO REMOVING THE COREBOX—THE TYPE OF ARBOR EMPLOYED IN THE CORES IS SHOWN TO THE RIGHT

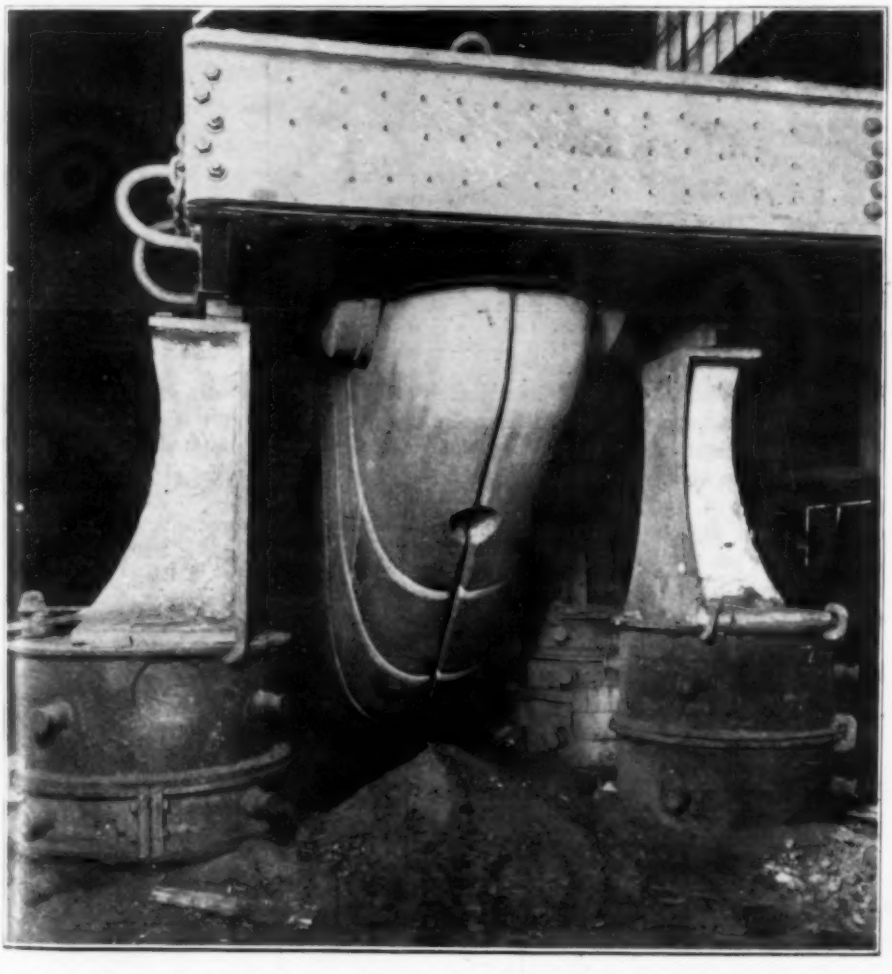


FIG. 9—THE ENTIRE SET OF CORES WAS ASSEMBLED IN THE DRAG, THEN THE COPE FLASK WAS PLACED IN POSITION, THE CORES WERE BOLTED TO THE BARS, THE COPE WAS RAMMED FULL OF SAND AND LIFTED OFF

Four salamanders similar in general features to that shown in the foreground, Fig. 3, were employed to dry the face of the mold. Coke fires were maintained for two nights and one day. The salamander at each end was suspended from a long steel bar resting on short steel rails that paralleled the walls of the mold. The two in the center were suspended from two light steel jib cranes. At first they were lowered close to the bottom of the mold and gradually raised as the drying progressed. The top of the mold was covered during the drying period by several thin, steel sheets that rested on a row of bricks and short pieces of rails surrounding the mold on the joint face.

After the mold was dried, it was cleaned and the cope was lowered into place. Balls of clay set on the face of the mold at several points were employed to test the accuracy of the metal thickness provided between the face of the core and that of the mold. The cope and core were removed temporarily while these flattened clay balls were being examined. Then the core and cope were returned to place. The runner box and risers were prepared and the long binders were placed across the top of the cope and bolted down. The anchor bolts attached to the bottom binders only extended to the floor level. Here each terminated in a loop. A comparatively short hook bolt was attached to each loop and the upper end extended through the binder for a sufficient distance to accommodate a suitable washer and nut by which a strain was brought on the rod.

(Concluded on Page 652)

Study Structure of Gray Iron

Discuss Macroscopic and Low Power Magnification Methods Which Reveal the General Structure of Gray Iron and Semisteel —Microphotography Is Considered

BY J. W. BOLTON

IN ALL testing work the primary requisite is that the sample be representative of the object to be examined. It must be uniform, so that different portions will give the same results.

In analytical testing of cast iron, it is well recognized that sampling must be carefully done to get uniform results. For example, combined carbon and graphite vary from the outer to the inner portions of the same bar. The fines from drillings, or millings contain much more graphite than the coarser drillings, and sulphur is likely to be much higher on the cope side.

In making practical use of microscopic methods of testing gray iron, the precautions necessary and the limitations of the method are not so well known. In this article the author will point out some of these limitations and explain methods used and results obtained from work on the general structure of commercial irons. In the laboratory of the Niles Tool Works, Hamilton, O., the author has found that the microscopic methods commonly used tell only part of the story, and sometimes a part that is misleading.

Microscopic photography at medium to high powers will give an accurate idea of the structure, and hence of properties of the steel if the structure is uniform. This is because the area photographed is so small. In cast iron the structure is not uniform, and the majority of investigators try to photograph a representative area. Personal equation plays so large a part in this selection that it is not always a correct method of procedure in studying cast iron.

FIG. 1—MICROGRAPH OF LOW STRENGTH CAST IRON SHOWING LARGE AREA—50 DIAM. UNETCHED

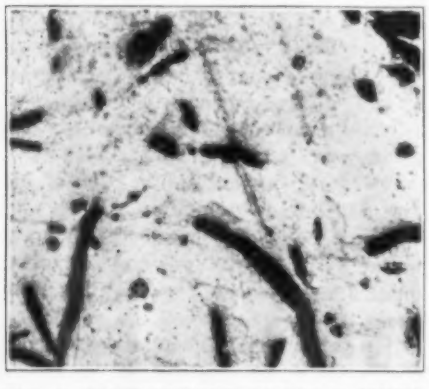


FIG. 2—SAME SAMPLE AS FIG. 1 SHOWING SMALL AREA WITH HIGHER MAGNIFICATION—100 DIAM. UNETCHED

Macroscopic methods have found general application in the examination of steels, and also have been used in testing nonferrous alloys. Insofar as the author is aware, they have not been used widely in the gray iron field.

Macroscopic methods fall under three classes. These are examinations for nonuniformity or mechanical heterogeneity, chemical heterogeneity, crystalline heterogeneity.

A common example of the first is the deep etching of steels. The portion of the sample to be examined is immersed in an acid solution made up of 1 part water to 1 part hydrochloric acid and allowed to stand for some time. In this way, mechanical defects of the material are made visible through the inequalities in attack of the reagent. The writer has found this method excellent for revealing grinding cracks in high speed cutters, seams in some steels, and cracks in forgings. It is not so useful when applied to gray iron. In this case the metallic portion dissolves out, leaving a spongy, dull-black, graphite coating over the sample. Even surface cracks are hard to discern under such conditions.

Some of the methods for detecting chemical heterogeneity are already known to most readers of THE FOUNDRY. Among these are sulphur prints and the copper reagents designed to indicate the parts rich in phosphorus. The writer has shown how the sulphur print method is liable to misinterpretation in an article in THE FOUNDRY, June 1, 1922, page 439.

FIG. 3—SAME SAMPLE AS FIG. 1 SHOWING SMALL AREA WITH HEAVY GRAPHITE—100 DIAM. UNETCHED

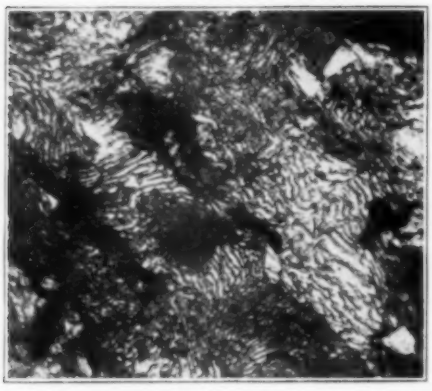


FIG. 4—STRUCTURE OF PEARLITE AT 600 DIAM. ETCHED WITH PICRIC ACID

Tells the True Story

AS CAST iron is not uniform in structure, it is essential that in the study of its formation and crystallization by metallography that lower magnifications should be used to cover a representative area by taking in all or a large portion of the surface. This will give an accurate knowledge of its structure and be of greater value to the investigator in predicting the properties of the metal than by the aid of high power microscopy, according to Mr. Bolton's opinion as stated in the accompanying article. The author defines clearly the difference in the terms macrostructure *and* microstructure *as applied to cast iron. By a number of illustrations he demonstrates the advantages and disadvantages of low and high power magnifications which simplify a hitherto complex problem. Using the correct magnification tells the true story.*

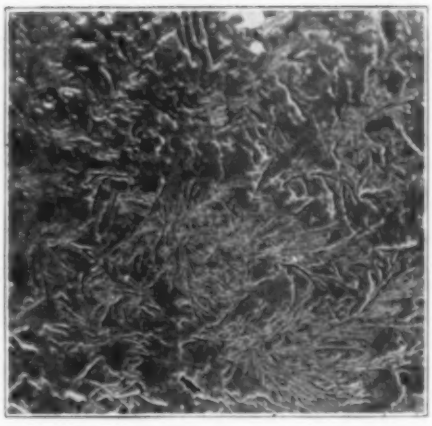


FIG. 7—COARSE GRAPHITE STRUCTURE ABOUT 10 DIAM. UNETCHED

440. Sulphides in the graphite flakes are first to be attacked. This will lead to the sulphur print showing *the distribution of graphite flakes rather than the distribution of sulphur.* In general, macroscopic methods have not proved to be of much value in showing chemical heterogeneity.

Describes Macrostructure

Macroscopic methods are useful in determining the crystalline heterogeneity of gray irons. The structure revealed by this method will be referred to as *macrostructure.* There are two ways of revealing macrostructure, by polishing and by etching. The first, although less generally used, gives the most significant results. The sample is polished carefully, enable one to judge the general structure accurately the sample being magnified 50 diameters unetched. Fig. 2 is from the same sample with a higher magnification showing a small area low in graphite and is enlarged 100 diameters by taking in all or a large portion of the surface, segregations are noted and their effects may be allowed for. Macrography means examination of a polished or an etched surface by visual inspection or at low magnification. The American Society for Testing Materials approves up to 10 diameters as limiting macrography. By low power microscopic methods the author refers to work up to 50 diameters. In addition to macroscopic and low power work, fracture studies are valuable to the gray iron worker.

Polishing of samples no matter how carefully carried out, results in relief effects. In other words the harder por-

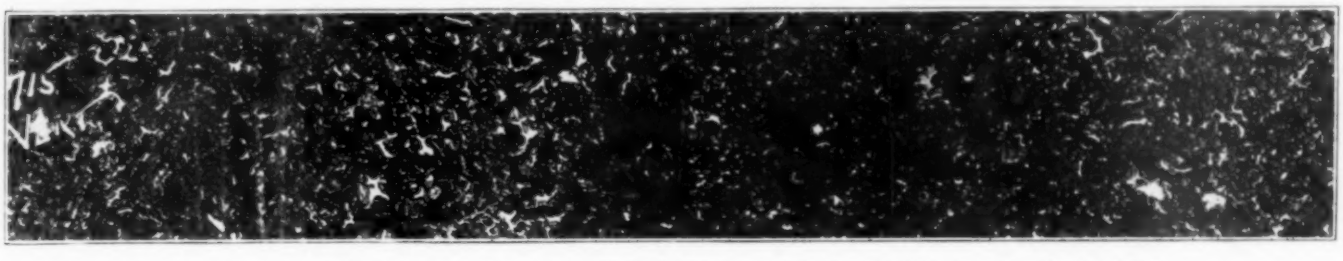


FIG. 5—GENERAL PEARLITIC DISTRIBUTION—50 DIAM. ETCHED WITH PICRIC ACID

exactly the same as for microscopic investigation.

As the distribution of graphite in cast iron is not uniform. A considerable area must be included in micrographs to obtain representative pictures. Fig. 1 is a composite micrograph of a low strength iron, showing enough area to unetched. Fig. 3 is the same sample, showing small area with heavy graphite magnified 100 diameters unetched. Fig. 1 tells the true story. Information given by Figs. 2 and 3 is apt to be misleading.

Macrographic and low power microscopic methods overcome this difficulty tions of the sample are slightly raised. Vertical light and photography does not show this condition. The relief is so slight that angled light beam will not always be apparent. Visual examination at various angles under a strong light reveals the general structure clearly, and any segregations or differences in struc-

FIG. 6—PORTION OF SAME SECTION AS SHOWN IN FIG. 7—50 DIAM. UNETCHED

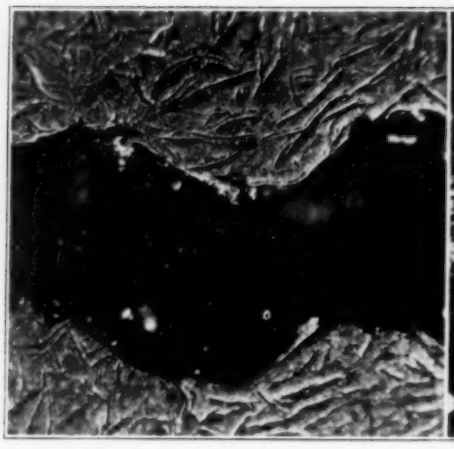


FIG. 8—FRACTURE FOLLOWS GRAPHITE FLAKES—10 DIAM. UNETCHED

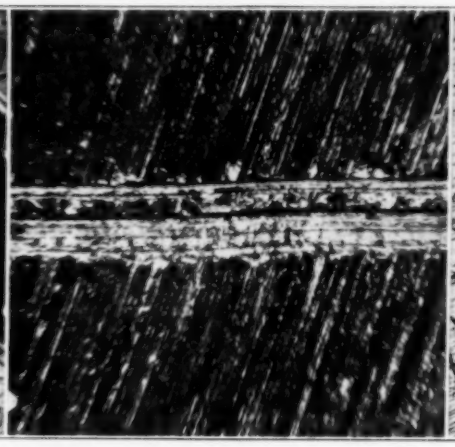


FIG. 9—HEAVY SCRATCH ON GROUND SURFACE—10 DIAM.

FIG. 10—COARSE GRAPHITE STRUCTURE—100 DIAM. GROUND

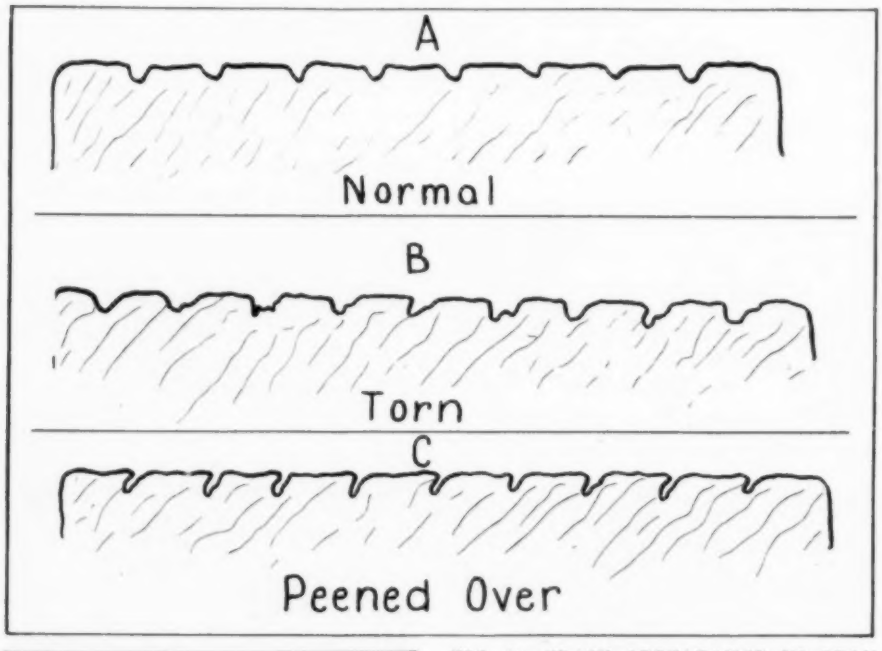


FIG. 11—GRAIN APPEARANCE IN GRAY IRON A. INDENTATIONS DUE TO GRAPHITE FLAKES B. THE EFFECT OF HEAVY MACHINING C. PEENING EFFECT BY GRINDING

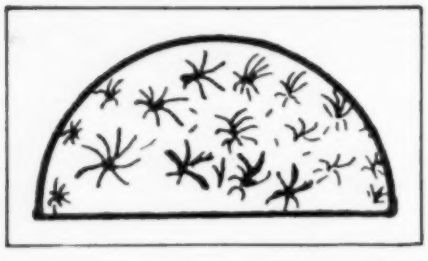


FIG. 12—LEFT—WHORL FORMATION OBSERVED IN WEAK CAST IRON

tures are quickly apparent. The method is particularly valuable in revealing the general distribution of the various carbon structures. Illustrations and practical examples are given in a later paragraph.

Etching to develop macrostructure has been used for some time. In this method the polished face of the sample is immersed for some time in dilute nitric acid, using a 1 to 1 down to 1 to 10 solution as the action of nitric acid is much more rapid than that of picric acid. This method brings out clearly the intercrystalline network structure. It also indicates the distribution of ferrite in irons low in combined carbon, if etching is not too prolonged.

With the knowledge gained from observation of the macrostructure, the metallographist is enabled to examine the microstructure intelligently. If segregations were apparent, any micrographs must be large enough to cover a representative area including a portion of the segregation. The magnification should be no greater than is necessary to reveal the significant structures clearly and this applies to all microscopic work. After much experimenting with many types of iron, the author has found that 50 diameters magnification is most satisfactory

FIG. 13—MICROGRAPH OF COARSE GRAPHITE STRUCTURE OBSERVED IN WEAK CAST IRON SHOWING PART WHORL FORMATION—50 DIAM. UNETCHED

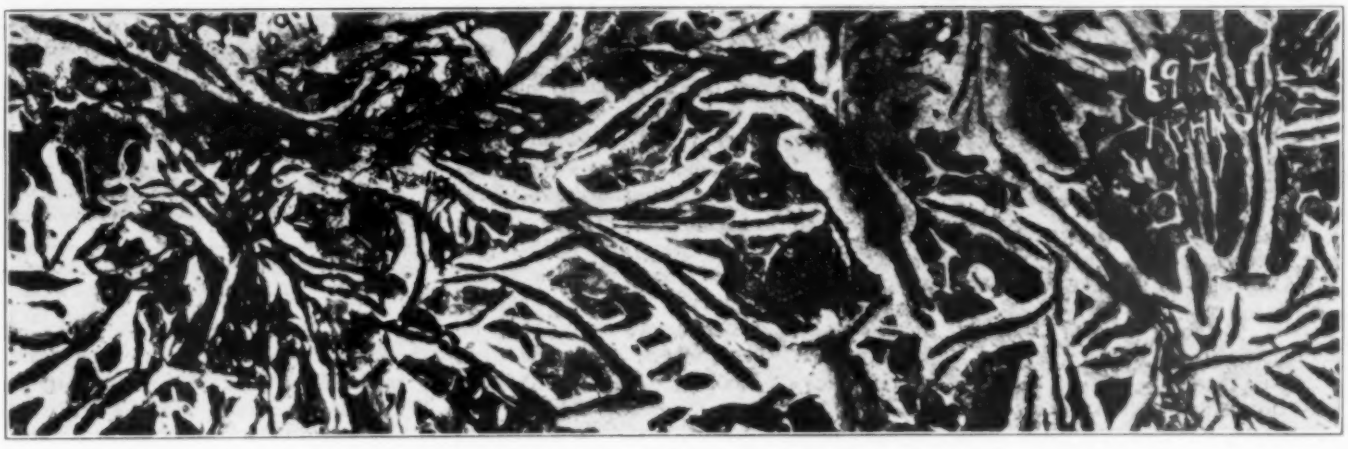


FIG. 14—MICROGRAPH SHOWING BROAD BANDS OF FERRITE ALONG THE GRAPHITE FLAKES SAME SAMPLE AS FIG 13, BUT ETCHED WITH PICRIC ACID 50 DIAM.

for general work, particularly for revealing the general distribution of graphite flakes. To examine the structural makeup of pearlite and steadite it is necessary to go much higher namely 300 to 700 diameters. In these latter cases the areas photographed are so small, being 1/100 inch or less in most cases, that a micrograph cannot be representative of the distribution of the components. At 50 diameters, a sufficient area can be photographed, especially by making composite prints.

The method of fractures, notwithtsanding its drawbacks, is excellent. Fracture indicates grain size and the physical properties in a satisfactory manner. Even an amateur can take a set of fractures and arrange them in order of their strength. Fracture methods fail in that they depend too largely upon personal equation, and cannot be measured, or photographed successfully. Samples change in appearance on keeping. Add to these objections that it is impossible to grade pig irons by fracture and it is easy to understand how foundrymen came to discard fracture methods.

Macroscopic and low power microscopic methods give a clear idea of the general structure of the sample. However, high power magnification is necessary to reveal the structure of some components. As an example Fig. 4 shows thumb print, laminar structure of pearlite at 600 diameters, etched with picric acid and, Fig. 5 a general pearlitic distribution, 50 diameters etched with picric acid. This illustration shows the size of the pearlite *crystals* and their approximate distribution. It does not show the fine laminar structure, as seen in Fig. 4.

The macrograph is excellent for determining the general structure. The micrograph reveals the details more clearly. Fig. 7 is a macrograph of coarse graphite structure magnified about 10 diameters unetched, and Fig. 6 is a micrograph of a portion of the same section, 50 diameters, unetched.

All our theories and tests are of little value unless they point the way to better materials—both in quality and in price. Those who have studied the metallurgical part of castings manufacture have found not only how to get better quality at the same cost, but often have been able to get lower costs. Quality in any material means strength and long life. We frequently have discussed graphite flakes because we have found they have much to do with the quality of the metal, in an inverse sense. The path of a fracture follows along the graphite flakes, and the more continuous the path, the weaker the metal. Hence, the importance of the flakes in determining the quality. This is clearly shown

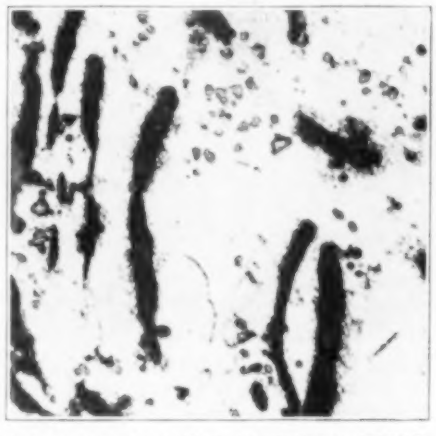


FIG. 15—MANGANESE SULPHIDE SEGREGATIONS SEEN IN WEAK CAST

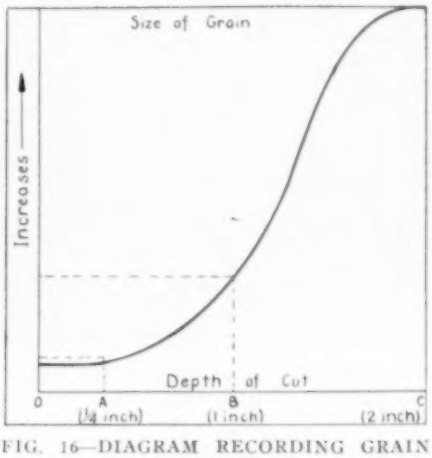


FIG. 16—DIAGRAM RECORDING GRAIN GROWTH

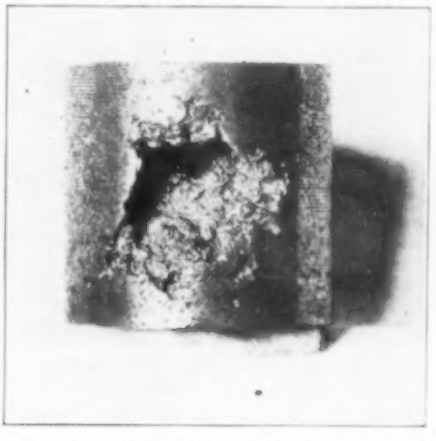


FIG. 17—SHRINKAGE HOLE DUE TO LOW TEMPERATURE POURING

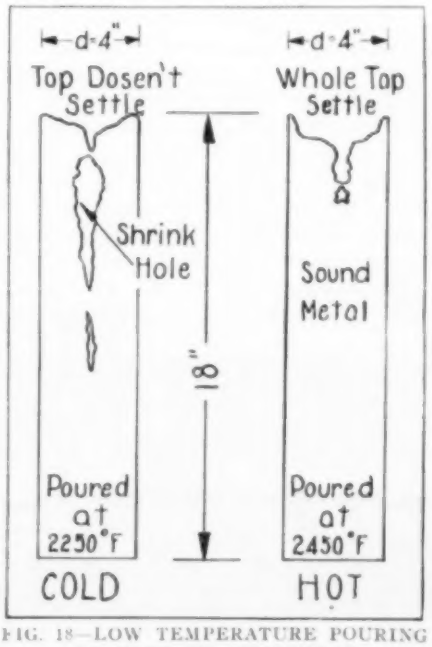


FIG. 18—LOW TEMPERATURE POURING RESULTS IN SHRINKAGE

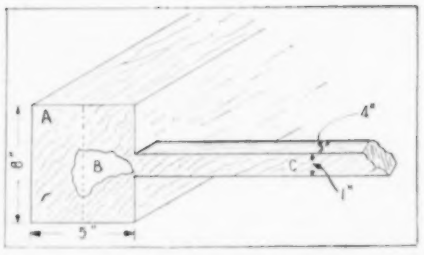


FIG. 19—UNEQUAL METAL SECTIONS ARE A COMMON CAUSE OF SHRINKAGE

in Fig. 8. The fracture follows right along the graphite flakes. The flakes seen in micrographs are usually the pits where the graphite flakes were, as can be seen in this macrograph which is about 10 diameters, unetched. Fig. 9 shows a heavy scratch on a ground surface. The grinding has completely covered up the graphite flakes. Evidences of the graphite structure may be seen by looking along the sides of the scratch. It requires little imagination to picture how heavy machining can tear up weak metal. This sample is about 10 diameter, ground. Fig. 10 shows coarse graphite structure partially covered over by the peening action of heavy grinding. Fine tool finishes, dragging the tool, filing, and heavy scraping, all have a similar, though less marked effect. Grinding does not necessarily mean poor metal, but poor metal can be made to look like nickel plate by grinding the sample shown is magnified 100 diameters, ground.

Grain appearance in gray iron is caused by the graphite flakes. This appearance may be changed materially by the different kinds of machining to which it is subjected. The reason for this is shown diagrammatically in Fig. 11, which represents cross sectional views of the same iron with different treatments. The portion, *A*, shows the indentations due the graphite flakes. There has been no distortion. This condition showing the true grain size is best produced by methods used by the metallographist, although machining with a sharp tool and moderate cut may be instructive. The part, *B*, shows the effect of heavy machining. The pits due the graphite flakes are greatly enlarged due to the tearing action. In *C* is shown the peening effect exerted by grinding or by several light finishing cuts.

There are two classes of weak irons, one structurally weak, the other with mechanical defects. Structurally weak irons have a coarse, dark fracture. Examination of the macrostructure of a polished section as explained in an earlier paragraph usually shows *whorl* formations as illustrated in Fig. 12.

These whorls probably are due to graphitization of eutectic cementite. Therefore they denote high carbon, and their large size indicates slow cooling. In some cases, large, poorly defined dendritic structures can be seen, indicating slow cooling and lower carbon. Occasionally there remain some traces of dendritic forms. The general structure reminds one of frost formations seen on window panes.

On examining with the microscope, preferably at 50 diameters, the unetched

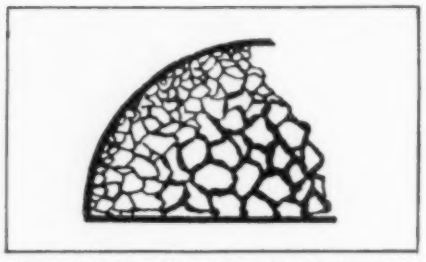


FIG. 22—METALLOGRAPHIC POLISHING SHOWS NETWORK MACROSTRUCTURE

specimen shows the characteristic coarse graphite flakes as illustrated in Fig. 13. These are generally grouped in *whorl* formations of coarse graphite structure seen in weak iron. The micrograph is too small to show the complete whorl formations. On etching, broad bands of ferrite appear along the graphite flakes, as shown in Fig. 14. The steadite is coalesced into large dendrites and there is rarely any evidence of network formations. In exceptional cases the iron is practically all ferrite and graphite, the pearlite having been completely decomposed. Fig. 14 is the same sample as Fig. 13 magnified 50 diameters but etched with picric acid. Note the ferrite surrounding the graphite, segregating especially near the graphite whorls.

Higher magnification often reveals segregations. Fig. 15 shows manganese sulphide segregations seen in a weak iron. Sulphur usually occurs in these little globules rather than in the mysterious network some writers claim. Of course, these inclusions weak-

FIG. 20—CHARACTERISTIC TYPE OF GRAPHITE STRUCTURE—THE WHORLS INDICATE HIGH CARBON—50 DIAMETER UNETCHED

FIG. 21—A MEDIUM IRON SHOWING FREE FERRITE—ETCHED WITH PICRIC ACID—50 DIAM.

en the iron in themselves, but this effect compared to that of the graphite flakes is insignificant. On the other hand, sulphur is known to raise the combined carbon and is thought to promote smaller grain size.

A structurally weak iron means that an improper mixture has been used. A mixture which would give 25,000 pounds tensile strength in a small section might give only 10,000 pounds in a heavy section. The foundryman has three factors to consider; section size or cooling rate, carbon, and silicon. He has no good means of controlling that vital factor, uniformity or rather, lack of uniformity of cooling rate in different parts of the casting. The common method is to arrange so that the outside is as strong as may be machined profitably and let the inside take care of itself. We have found out how to make irons much better in the inside of sections, but have not yet made the inside portions as good as the outer portions.

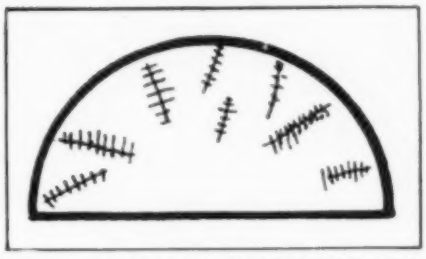


FIG. 25—DENDRITIC MACROSTRUCTURE OFTEN OBSERVED IN HIGH-TEST CAST IRON

Fig. 16 shows grain growth. Near the outer edge, say the first quarter inch, point *A* the metal will show fairly close grained, even on rather weak irons. From ¼ to 2 inches cut there is a rapid increase in grain size in weak irons and some increase in the better grades, as shown in *B*. From 2 inches on there is little increase, a maximum being attained at *C*. The figures given are rough approximations and are affected by the grade of iron, the total depth of section, and many other factors.

Fig. 17 is a good illustration of a shrinkage cavity. This piece was taken out of the center of an 8-inch bar poured dull. Note the jagged appearance, so different from the smooth shiny appearance of blowholes.

Many failures attributed to weak, open grain metal really are due to shrinkage which generally is easy to diagnose. It occurs as dull, jagged cavities surrounded by areas of more or less spongy metal as shown in Figs. 17, 18 and 19. Careful examination of the cavity will reveal portions covered with little, moss-like flakes, resembling small pine trees. These formations largely are due to crystals of prima austenite, the first component to freeze out. Contraction of some other part of the casting has drawn away the liquid portions of the metal, leaving some of these tiny dendrites. In cold weather, when we drain our radiators and leave the buckets of water stand over night, we may have found the mixture partly frozen the next morning. That is the condition of a casting just before shrinkage starts—it is partly frozen. Suppose we pour off the water, and have needles of ice left. That is what happens when contraction draws away the liquid part of the metal—and as in the case of the water, the frozen crystals remain.

Some shrinkages are only partial, resulting in spongy, open areas, which generally are local and show up near the same part of the casting. In other cases the moss-like crystals may have remelted a little, resulting in a smoother appearance in the cavities. Shrinkage is not blowholes and blowholes have nothing to do with shrinkage. The two most common causes of shrinkage are poor design and dull pouring, which are illustrated in Figs. 18 and 19.

Uniformity of sections is the first axiom in design, from the foundry viewpoint. The foundryman who takes castings having abrupt changes from large to small sections is courting trouble. For example, that little bead or fin on the back of a gear face is likely to weaken the teeth by promoting shrinkage at their base. Low temperature pouring of certain types of heavy pieces results in shrinkage as shown in Fig. 18. The top, sides and bottom freeze before the

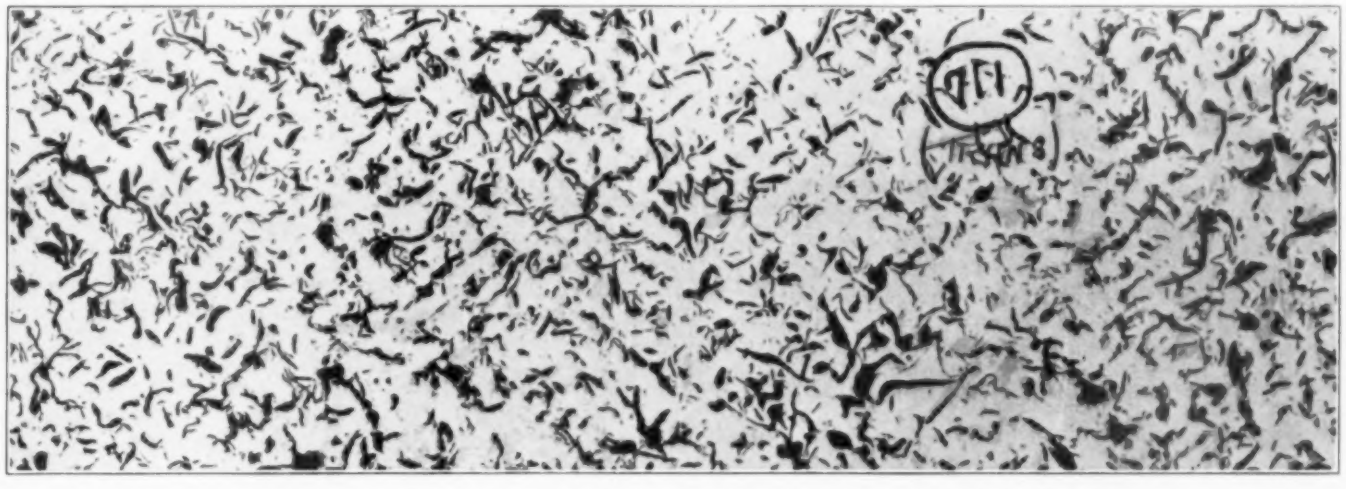


FIG. 23.—MICROGRAPH OF HIGH TEST CAST IRON SHOWING EVIDENCE OF DENDRITIC STRUCTURE—50 DIAM. UNETCHED

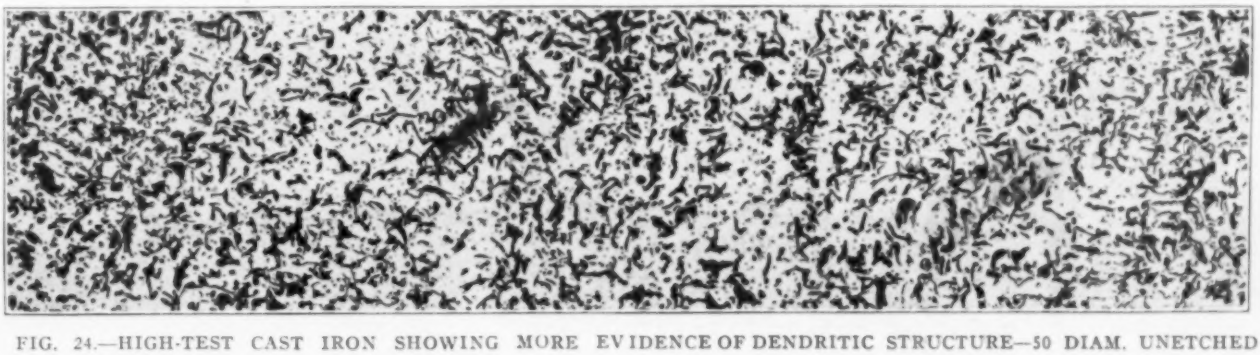


FIG. 24.—HIGH-TEST CAST IRON SHOWING MORE EVIDENCE OF DENDRITIC STRUCTURE—50 DIAM. UNETCHED

interior. The outside in contracting draws away the still partly liquid metal of the interior. The conditions are analogous to those which are responsible for various types of pipe in steel ingots. In case of thinner sections, dull iron may be a cause of blowholes, by freezing on entrapped gas bubbles.

Familiar examples of shrinkage caused by design, low temperature pouring, and other factors are shown in Fig. 19. A cross section of a gear of exaggerated design is shown in this illustration. Here *A* is the tooth and *B* the shrinkage cavity, which shows at base of tooth; while *C* is the arm, which is proportionately too thin. In setting and contracting the arm pulls away the still liquid portion at *B*. Trouble may be overcome by thickening the section at *C*, using a large fillet, and feeding properly.

The question of feeding is important and many shrinkage troubles may be overcome by proper feeding. Strong semi-steel castings have greater tendency toward shrinkage and must be fed more thoroughly than soft iron castings. Risers are of little advantage unless they are large enough to help feed the casting while it is solidifying. Too small risers freeze before the part of the casting they are supposed to feed, and actually may cause shrinkages.

The majority of irons made today fall in what we may term the medium class. Such irons look well and cut well. They are strong enough for their purpose, but can hardly be classed as high test irons. They show a fairly dark fracture, with small grain. On metallographic polishing they usually have a network macrostructure. Micro-examination reveals medium to small graphite, rather unequally distributed often seen in irons of medium to fairly high strength. Such irons, in medium sections have silicon 1.50 to 2.25 per cent and total carbon 3.40 to 3.70 per cent. They will run from 2800 to 3300 pounds transverse on the standard bar test and their combined carbon on such a bar will be from 0.40 to 0.55 per cent.

High test irons have come into favor because the buyer knows that they have great strength and will give good service. Such irons will run from 3800 to 4500 pounds on the standard test bar. A few run 5000 pounds and over. Brinell hardness is around 200, yet if the phosphorus is kept low enough, the castings will machine well. Care must be used to combat greater tendency to shrinkage. Analysis of the test bar usually will show silicon 1.00 to 1.50 per cent and carbon 3.00 to 3.50 per cent with combined carbon about 0.75 per cent. Fracture is a fine, light gray. Macrostructure usually appears somewhat dendritic near the edges as shown in Fig. 25. Microstructure shows small graphite, evenly distributed except for the dendritic formations as noted in Figs. 23 and 24. Large whorls of graphite resulting from formation of eutectic cementite and its subsequent decomposition and growth of graphite are notably absent. The etched sample shows an eutectoid or pearlitic matrix, with some steadite.

Fig. 20 is a characteristic type of graphite structure. The whorls indicate high carbon and the size of the flakes shows that there was some grain growth. Such irons often are quite uneven in structure, some parts being much coarser than others. This is magnified 50 diameters, unetched.

Fig. 21 is a medium iron, etched with picric acid and magnified 50 diameters. Some free ferrite is evident. This micrograph is from a sample somewhat lower in strength than that shown in Fig. 20.

Fig. 25 shows dendritic macrostructure often observed in high test irons. This indicates low carbon. The dendrites are small, giving an acicular appearance, indicating fast cooling. Some free cementite may occur along the outer edges. Any network macrostructure is fine grained. Fig. 23 is a micrograph of a high test iron magnified 50 diameter. This iron is a specimen of 5610 pounds transverse strength on the standard bar is low in total carbon, with about 0.80 per cent combined carbon.

The micrograph shows small graphite evenly distributed.

Fig. 24 is another high test iron of 4915 pounds tensile strength and showing more evidence of dendritic structure. It is magnified 50 diameters unetched. Many irons around the high test specification of 3800 pounds transverse test show evidence of both ledeburitic and dendritic forms, both forms which may be termed primary graphite. An explanation of these various formations is given in the Aug. 15, 1923 issue of THE FOUNDRY, page 658.

Inaugurate New Plant for Auto Malleables

The Flint Malleable Castings Co., Flint, Mich., has been incorporated for $500,000 by several business men of Flint. The plans of the company include the building of a main plant on the new belt line railroad, 300 x 1140 feet. The annual output of the plant will be 7000 tons. Contracts have been signed with several large motor plants, the incorporators say. The officers are: President, John M. Barringer; vice president, Fred J. Weiss; secretary, Carl W. Bonbright; treasurer, Edward N. Atwood; director, Charles H. Bonbright and director of sales, Charles A. Reynolds.

Firebrick To Resist High Temperatures

By George A. Drysdale

Question: We have several mixtures which require an unusually high temperature in our coke fired furnaces, and would like to obtain some information as to a special firebrick which will stand up under these high temperatures, and yet be suitable for use in this type of furnace.

Answer: In general firebrick for foundry use may be divided into two grades. First grade firebrick is intended to resist the higher temperatures and excessive wear in the greatest degree, and should be made of best grade fireclay, hard, tough, and dense in structure. Such a brick is used for the lining in the melting zones of the various furnaces such as the cupola, air-furnace and open hearth. The second grade brick usually is made of the same kind of material but not finished to size as carefully as first grade brick. The second grade is used for annealing oven work, the upper lining of cupolas and where the temperatures are lower.

The chemical analysis of firebrick does not constitute a sole guide to its merits. The physical structure is considered of great importance. For coke furnaces where high temperatures are used we would suggest the first grade firebrick to render the best service.

Form Sales Corporation

The Gulf States Pipe Corp. recently was formed to handle the output of several pipe foundries located in Anniston and Birmingham, Ala., and Knoxville, Tenn. The main offices of the new corporation will be located in Anniston and Whitfield Clark, president, will be in charge. A branch office will be opened in Chicago and other market centers. The annual output of the foundries which have placed their selling in the hands of the new corporation is approximately 100,000 tons. The foundries which have joined the new corporation are as follows: The Emory Foundry Co., the Independent Soil Pipe Co., the Rudisell Soil Pipe Co., and the Interstate Foundry Co., Anniston; the Southern Pipe & Foundry Co., Knoxville; the Southern Pipe & Foundry Co. and the Kilby Pipe Co., Birmingham.

The Eagle Iron & Brass Foundry, Passaic, N. J., has purchased the Gillespie Foundry Co., Paterson, N. J. The latter was built by the Gillespie Eden Corp. in 1920 and is modern and completely equipped.

Cut to this point →

TYPICAL ANALYSES OF MISCELLANEOUS COMMODITIES USED IN FOUNDRY PRACTICE

By J. M. Quinn

Commodity	Name Symbol	Chromic Oxide Cr_2O_3	Silica SiO_2	Iron Fe	Ferric Oxide Fe_2O_3	Phosphorus P	Manganese Mn	Alumina Al_2O_3	Calcium Oxide CaO	Manganous Oxide Mg O	Sulphur S	Loss	Water H_2O	Source of Data
OXIDIZING AGENTS														**OXIDIZING AGENTS**
Cinder—Plate Mill—Dried		.....	5.50	68.61	.....	0.016	0.51	2.89	0.36	0.31	.....	.....	.....	Illinois Steel Co., Gary....1914
				Fe O										
Ore—Imperial Chrome—Natural		49.78	6.36	.....	14.11	.....	0.45	16.38	.....	11.18	.....	2.04	.....	Illinois Steel Co., Gary....1914
Ore—Turkish Chrome—Natural		39.84	10.22	.....	12.95	.....	0.71	14.12	.....	19.93	.....	2.38	.....	Illinois Steel Co., Gary....1914
Ore—Turkish Chrome—Natural		51.70	3.50	14.20	.....	.....	.....	14.10	1.70	14.30	.....	.....	0.3	Bureau of Mines, Bulletin 77, Washington....1916
Ore—New Caledonia Chrome		55.70	0.20	13.20	.....	.....	.....	16.20	0.25	9.80	.....	.....	1.05	Bureau of Mines, Bulletin 77, Washington....1916
Ore—California Turkish		52.68	3.40	15.30	.....	.....	.....	11.40	.....	16.23	.....	.....	0.94	Bureau of Mines, Bulletin 77, Washington....1916
Ore—Cuban Chrome		50.00	3.82	18.57	.....	.....	.....	12.44	2.16	13.38	0.690	.....	.....	Bureau of Mines, Bulletin 77, Washington....1916
		Boron Oxide B_2O_3												
Ore—Colemanite		27.23	.....	.....	Trace	.....	.....	.....	28.80	.....	.....	.....	25.30	Bureau of Mines, Bulletin 77, Washington....1916
Ore—Hard Vermillion Iron—Natural		.....	5.59	63.60	.....	0.147	0.08	1.17	0.66	0.42	0.019	0.47	0.81	Illinois Steel Co., Gary....1913
Ore—Hard Beresford Iron—Natural		.....	5.12	62.64	.....	0.018	0.06	2.40	0.66	0.52	0.030	0.61	0.91	Illinois Steel Co., Gary....1913
Ore—Soft Chapin Iron—Natural		.....	5.34	55.39	.....	0.061	0.21	1.48	1.32	3.38	0.013	2.24	6.75	Illinois Steel Co., Gary....1913
Ore—Soft Clearfield Iron—Natural		.....	4.64	49.43	.....	0.107	0.22	2.76	3.19	2.32	0.223	4.36	11.38	Illinois Steel Co., Gary....1913
Ore—Manganese—Natural		.....	5.10	.....	4.92	0.089	43.42	9.92	.....	.....	.....	17.20	10.15	Southern Manganese Corp., Anniston....1917
Ore—Manganese—Natural		.....	4.72	.....	4.83	.....	42.95	10.75	.....	.....	.....	17.20	.....	Southern Manganese Corp., Anniston....1917
Ore—Manganese		.....	7.80	1.45	.....	0.173	51.60	1.12	1.80	2.18	.....	.....	.....	Bureau of Mines, Bulletin 77, Washington....1916
		Molybdenum Mo												
Ore—Molybdenite		47.50	13.90	1.23	.....	0.608	.....	.....	.....	.....	30.64	.....	.....	Bureau of Mines, Bulletin 77, Washington....1916
		Tungsten Oxide WO_3						Manganese Oxide MnO						
Ore—Wolframite		69.80	2.00	.....	20.05	Trace	.....	7.3	.....	.....	0.20	.....	.....	Bureau of Mines, Bulletin 77, Washington....1916
Ore—Wolframite—Boulder, Colo		30.96	34.44	10.20	.....	.....	0.82	.....	.....	.....	.....	.....	.....	Bureau of Mines, Bulletin 187, Washington....
Scale—Billet Mill—Natural		.....	2.26	68.53	.....	0.019	0.51	.....	.....	.....	.....	.....	2.40	Illinois Steel Co., Gary....1914
Scale—Plate Mill—Natural		.....	0.40	70.43	.....	0.012	0.36	.....	.....	.....	.....	.....	1.86	Illinois Steel Co., Gary....1914
Scale—Rail Mill—Natural		.....	1.93	68.92	.....	0.020	0.46	.....	.....	.....	.....	.....	2.28	Illinois Steel Co., Gary....1914
		Titanium Oxide TiO_2			Ferrous Oxide FeO									
Ore—Titaniferous		34.36	4.14	.....	50.53	.....	.....	2.20	.....	.....	.....	.....	.....	Bureau of Mines, Bulletin 77, Washington....1916

Do not cut—Fold along this line for binding

Cut to this point →

Note—This sheet may be cut along this line and one half folded over on the other to bind in a 5 x 7 inch note book

THE FOUNDRY DATA SHEET, AUG. 15, 1924

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

STERLING WHEELBARROW COMPANY

I R SMITH Pres & Treas
C F SMITH Vice Pres
H H BAKER Secy

MILWAUKEE, WIS. U.S.A.

BRANCHES
CHICAGO ILLINOIS
NEW YORK, N Y
DETROIT MICHIGAN
CLEVELAND OHIO
BOSTON, MASS
ST LOUIS, MO
PHILADELPHIA PA

June 5th, 1923.

Mr. J. D. Pease
% The Foundry
Penton Publishing Co.
Cleveland, Ohio

Dear Sir:-

We have your letter of May 24th asking us what we think of the FOUNDRY as an advertising medium and whether or not we have been satisfied with the services you have been rendering us.

It is our pleasure to state that we are thoroughly satisfied with the services which you have always rendered us and the results obtained thru our advertising in the FOUNDRY are most gratifying.

Our line which includes rolled steel flasks, foundry trucks, special foundry wheelbarrows, boxes, wedges, casters and wheels is a product for which every foundry has constant need. It is, therefore, necessary for us to reach the entire foundry field regularly. It is our opinion that the most effective way to reach this field is thru your publication. We have carried full page space in your publication ever since we had a foundry line to sell and it will be our policy to continue with you each issue with full page space.

Yours very truly,
STERLING WHEELBARROW CO.

HHB:DS

SECRETARY

Standardizing Test Methods

Joint Committee on Molding Sand Research Publishes Report of Activities—Describes Tentatively Adopted Methods for Determining Cohesiveness, Permeability, Fineness and Dye Absorption

FOR some time previous to 1921, the lack of standardized testing methods for foundry sands had been realized by foundrymen, who were unable satisfactorily to select and control their sands. Many favored a complete investigation to uncover deposits of sand which would be of value in foundry work, but which had not been made available for use, and to determine methods for reclaiming used sand. Factors involved in the problems of finding new sands and of reclaiming used sands had been emphasized during the world war, with its heavy demands on the American foundry industry.

The problem of studying the various types of foundry sands was so extensive that a large representative joint committee was deemed essential by the American Foundrymen's association, which representative body undertook to sponsor the work and to secure the co-operation of other organizations whose activities relate directly to the important phases of the investigation. Organization of the joint committee was definitely effected in December, 1921. The National Research council first agreed to co-operate through its engineering division, and the American Society for Testing Materials later became identified with the movement and appointed three representatives to serve on the joint committee. The United States bureau of standards, bureau of mines, geological survey and the Canadian department of mines, now are represented officially. A chairman and executive committee were selected to exercise control over the entire investigation, except the handling of funds which was in charge of the treasurer of the American Foundrymen's association. The personnel of the joint committee, the executive committee and its subcommittees have experienced few changes since the membership first was published. In November 1923, R. A. Bull, resigned as chairman of the joint committee and was succeeded by Walter M. Saunders, who previously had been a member of the joint committee. This was noted in The Foundry.

Progress reports of the joint committee on molding sand research were made at the Cleveland convention of the American Foundrymen's association, May 1, 1923, and recently have been published in a report of the committee. Mr. Bull, chairman of the committee reported on the finances and described the work accomplished to that date ,which chiefly was concerned with developing suitable methods for testing the sand. He explained that three essential methods of tests, to determine bonding strength or cohesiveness, fineness and permeability, were tentatively adopted for one year's trial in as many foundries as possible. Two supplementary methods, one for making chemical analysis and the other for dye adsorption, were submitted for similar trial and a method of sampling was tendered.

H. Reis, chairman of the subcommittee on geological surveys, presented a report covering the activities of the committee in stimulating investigations of the sand resources of the different states. He stated that a number of state geologists were co-operating in making surveys and that samples were being tested at the bureau of standards, Washington, and at Cornell university, Ithaca, N. Y. The report of the subcommittee on conservation and reclamation was presented by F. L. Wolf, chairman. This committee sent a questionnaire to the foundries in the United States, but the percentage of returns was exceptionally low and the information given of little value.

The various tests tentatively adopted were mentioned in a report of the subcommittee on testing, presented by H. B. Hanley, chairman.

The bonding or cohesiveness test was described fully in the July 1, 1923 issue of THE FOUNDRY, page 545. The apparatus recommended for testing the permeability of molding sand was described in the July 15, 1923 issue of THE FOUNDRY, page 587. However, this test has been revised by the committee, the new method being published in the recent report of the joint committee on molding sand research which is reviewed in the following article. Other results of molding sand investigations to date as reported to the American Foundrymen's association through the report just issued, will follow in early issues of THE FOUNDRY.

Apparatus Determines Permeability

PERMEABILITY, as used in this test, is that physical property of sand which permits the passage of gases. It is upon this property that the venting qualities of sand molds and cores depend, a sand of high permeability having good venting qualities because of its open structure. Important factors regulating the degree of permeability are the natural characteristics of the sand and the binders, the density with which these are packed and the percentage of moisture used for tempering. The object of the permeability test is to determine that physical property called permeability. This is ascertained by measuring the rate of the flow of air through a standard specimen of sand under a given pressure. It may have for its purpose, making standardized tests or the routine control of sand mixtures in foundry operations.

The parts of the permeability apparatus are as follows, the dimensions being shown in Fig. 2. Tank *A* Figs. 1 and 2, is made of copper, tin lined, and is provided with a vertical air outlet coming up through the bottom. When in use the tank is filled with water, a stop-cock being provided on the side of the tank at the bottom to drain the water when the apparatus is not in use or when adjusting the water level. The bell *B* has a vertical tube, *C*-1, Fig. 2, which slides inside the air outlet tube, *C*-2, Fig. 2 in the tank *A*. Several vents near the top of this tube permit the air to be forced out of the bell *B*. A three way valve *D*, shown assembled in Fig. 1, is attached to the lower end of the outlet tube from the tank *A*. The opening in the valve should not be too small, preferably not less than 0.12 square inches, so as to permit the air to pass through freely. The parts of this valve are shown as *D*1 to *D*4 inclusive, Fig. 2. A valve indicator, *D*3, is provided, marked *on*, *off* and *vent* to show that the valve is in position to let air from bell *B* through the sand container *E*, to shut the flow of air from the bell, or to

permit air to enter the by-pass while raising the bell. A nipple *G* over which fits a rubber stopper *H*, which is held in place by two locknuts, *I* and *J*, is attached to the lower side of the valve. An orifice plate *K* for use in rapid work, is screwed into the lower end of the nipple *G*. One of the orifice plates may be seen on the shelf at the base of the tank. The rubber stopper *H* fits into the sand container *E*. A manometer *F*, having the scale divided into centimeters and millimeters, is located in front of the tank *A* and which connects with a brass tube that passes down through the rubber stopper *H*. All parts are of brass, except those described as being made of other materials, and except the stand or the base.

As the bell sinks into the water in the tank, it forces air into the outlet pipe *C*-1, Fig. 1, through the valve *D* and through the sample of sand packed in the container *E*. The pressure of the air is read on the manometer. Since the pressure recorded on the manometer depends on the weight of the bell *B* and on its cross sectional area, the weight should be made such as to give a pressure of about, but not less than 1.1 ounce per square inch, or five grams per square centimeter. A weight also should be provided to place on top of the bell to increase the manometer reading to 10 centimeters, as that pressure is more convenient for testing fine sands and for rapid work. A bag of shot makes an easily graduated weight.

Bell Is Marked

The bell *B* has several marks on it, the lowest being *X*, the second *O*, the next 1000 and the fourth 2000. These indicate that the capacity of the bell between the 0 and the 1000 marks is 1000 cubic centimeters or 61 cubic inches, and between 0 and 2000 is 2000 cubic centimeters or 122 cubic inches. The object of having the mark *X*, which is about ¾ inch, 19 millimeters, below the zero mark, is to insure raising the bell to the proper height, so that when it is necessary in a standard test to read the time required for the bell to sink from zero to 1000 or 2000, the zero mark will remain clearly visible.

The bell is raised by turning the indicator on the valve plug to the position marked *vent*. This allows the air to enter through the by-pass instead of having to be drawn through the sand. By turning the indicator to the *off* position, the bell will remain in the raised position. When the operator is ready to start the test the indicator is turned to the *on* position which causes the bell to sink as air is forced through the valve.

The sand container *E*, Fig. 1, is a brass cylinder 5 inches, 12.70 centimeters, high and 2 inches, 508 centimeters inside diameter. The sand rammer is shown in Fig. 3 and the detailed drawing of the machine in Fig. 4. This device consists of a steel rod supported on two guides. A steel disk is attached to the lower end of the rod and has a sliding fit in the sand container. A cast iron rammer head, weighing 14 pounds, 6350.36 grams, slides in the rod, its movement being regulated by two stops. The distance between these stops is sufficient to permit a 2-inch movement of the rammer head. A pedestal is provided on which the sand container rests while the sand is being placed on it and while the ramming operation is being performed.

On top of the upper steel guide a scale with three lines marked on it is attached. If the upper end of the rammer rod is between the upper and lower of these lines after the third ram, it indicates that the sand sample is within the allowable limits of thickness. If dry sand is to be tested, a special cap having a 20-mesh brass screen bottom is used to slip over the end of the sand container. For ramming dry sand the pedestal may be placed upside down under the container. This supports the screen during ramming and keeps the sand sample at the proper height to use the tolerance marks as a guide.

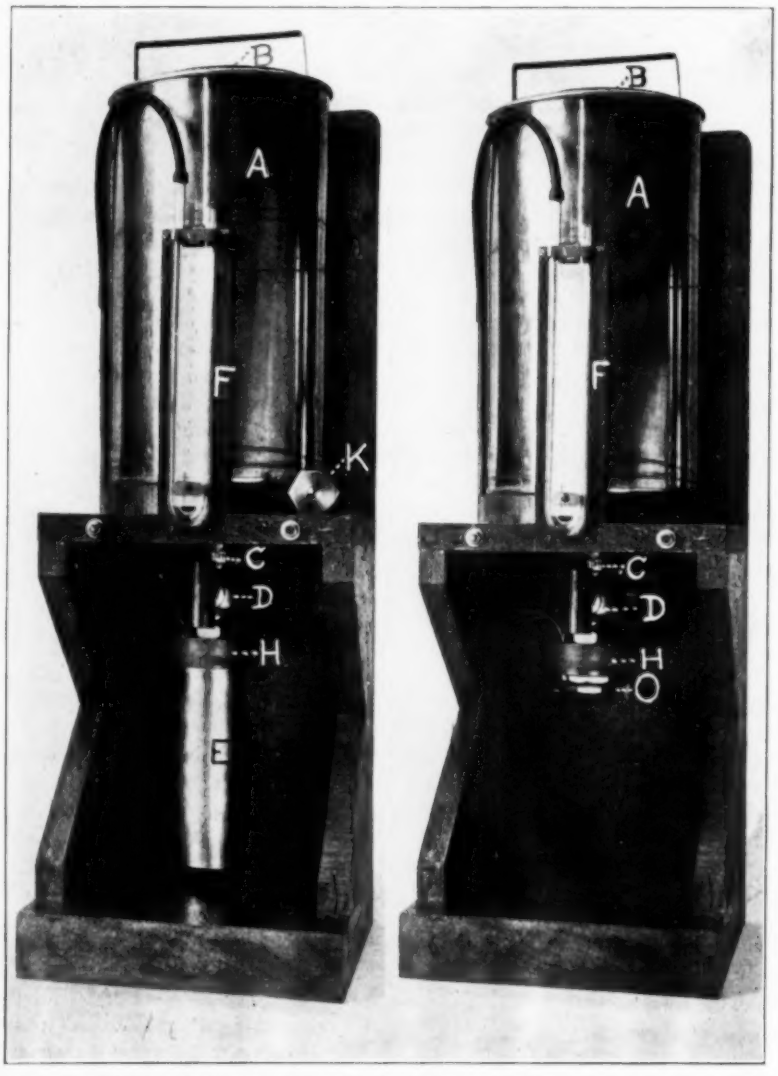


FIG. 1—PERMEABILITY TESTING APPARATUS—THE DEVICE ON THE LEFT HAS THE SAND CONTAINER *E* IN PLACE READY FOR TESTING

Average Sample Necessary

The sample to be tested should be an average one, representative of the heap, floor, car, bank or other sources from which the sand is taken. Detailed directions for sampling molding sands as shipped or delivered will be published in an early issue of THE FOUNDRY.

In testing for permeability it is necessary that the sand be sampled properly and uniformly tempered. For a plant check or control tests upon facing or heap sands in daily use, one may test the

Permeability Test Pressures and Values

Pressure	Permeability Small orifice .5 millimeters	Permeability Large orifice 1.5 millimeters	Pressure	Permeability Small orifice .5 millimeters	Permeability Large orifice 1.5 millimeters	Pressure	Permeability Small orifice .5 millimeters	Permeability Large orifice 1.5 millimeters	Pressure	Permeability Small orifice .5 millimeters	Permeability Large orifice 1.5 millimeters
.1	...	....	2.6	36	326	5.1	14.3	134	7.6	6.3	61
.2	...	....	2.7	34	313	5.2	13.8	128	7.7	6.0	58
.3	...	....	2.8	33	300	5.3	13.4	126	7.8	5.8	56
.4	273	2450	2.9	31	287	5.4	13.0	122	7.9	5.6	54
.5	217	2000	3.0	30	275	5.5	12.6	110	8.0	5.3	52
.6	176	1620	3.1	29	264	5.6	12.2	115	8.1	5.1	50
.7	154	1350	3.2	28	253	5.7	11.8	112	8.2	4.9	48
.8	133	1200	3.3	27	243	5.8	11.4	108	8.3	4.7	46
.9	117	1060	3.4	25.8	235	5.9	11.0	105	8.4	4.4	44
1.0	105	950	3.5	24.2	226	6.0	10.7	102	8.5	4.2	42
1.1	93	850	3.6	23.4	219	6.1	10.3	99	8.6	4.0	40
1.2	80	780	3.7	22.7	212	6.2	10.0	96	8.7	3.7	38
1.3	79	710	3.8	21.8	205	6.3	9.7	93	8.8	3.5	36
1.4	72	650	3.9	21.0	198	6.4	9.4	90	8.9	3.3	33.4
1.5	67	610	4.0	20.0	193	6.5	9.0	88	9.0	3.1	32.0
1.6	62	550	4.1	19.5	185	6.6	8.8	85	9.1	2.9	30.0
1.7	58	525	4.2	19.0	178	6.7	8.5	82	9.2	2.6	27.8
1.8	55	492	4.3	18.4	173	6.8	8.2	80	9.3	2.4	25.6
1.9	52	467	4.4	17.8	167	6.9	7.9	77	9.4	2.2	23.2
2.0	49	440	4.5	17.3	163	7.0	7.7	75	9.5	1.9	21.0
2.1	47	417	4.6	16.7	156	7.1	7.5	73	9.6	1.7	18.4
2.2	44	398	4.7	16.2	151	7.2	7.2	70	9.7	1.4	..
2.3	42	376	4.8	15.7	146	7.3	7.0	67	9.8	1.1	..
2.4	40	358	4.9	15.2	142	7.4	6.7	65	10.0	..	..
2.5	38	341	5.0	14.7	138	7.5	6.5	63	..	..	..

sand as it is tempered for molding.

To determine the maximum permeability under suitable foundry working conditions, experiments should be made with several water contents to ascertain that amount which develops the maximum degree of permeability. It is advisable in most cases to try percentages of water beginning with 4 per cent and increasing by stages of 2 per cent up to and including 8 per cent. However, it may be found difficult to make a test with the water content at an exact predetermined amount. The permissible amount of deviation from the predetermined figure should not be more than ½ per cent, and may be intelligently determined by the careful experimenter who observes critically the tendency of the sand to show widely differing permeability values as the water content is changed appreciably. A deviation not to exceed 0.2 per cent may be considered satisfactory for the determination of the permeability at the nearest fixed percentage. The exact percentage of moisture, even if within 0.2 per cent, should be reported. Supplementary tests with lower than 4 per cent and higher than 8 per cent of water should be made when the facts ascertained justify such a test. For example, when a cohesiveness value considered proper to report is obtained on a sand with a moisture content lower than 4 per cent or higher than 8 per cent and a permeability value of the sand is desired, a test for permeability should be conducted with the sand tempered with the same amount of water as in the case of the cohesiveness test. In such cases, a sufficiently large sample of sand should be tempered to permit the making of both tests.

The following procedure is followed in examining the sand. One thousand

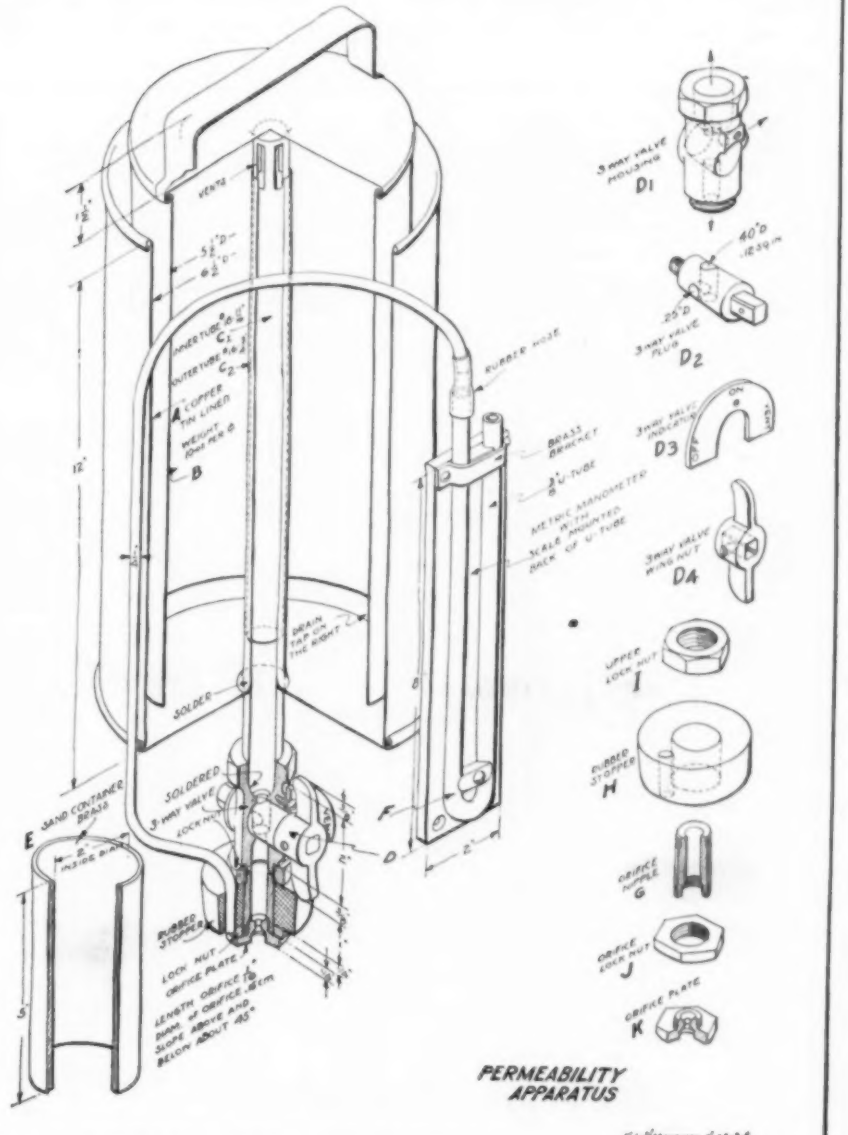


FIG. 2—PARALLEL PERSPECTIVE DRAWING OF PERMEABILITY TESTING APPARATUS

grams of sand is selected according to the directions for sampling molding sand and is dried for one hour at a temperature not below 105 degrees Cent. or above 110 degrees Cent. Care should be exercised to spread the sand over a large area in a thin layer to expell all moisture in a given time. This will make possible the adding of the proper amount of water to give the sand the desired moisture content. After the sand has cooled, the desired quantity is measured and the water added, allowance being made for evaporation. Thus, if it is desired to add 4 per cent water and ½ per cent extra water is needed, 47 cubic centimeters would be added to 1000 grams of sand.

The sand is spread flat on a dry surface in a layer about 1-inch thick to temper, and a small quantity of water is sprinkled evenly over the sand and later worked in gradually. This operation is continued until all of the water has been distributed thoroughly through the sand. There should be no dry lumps or other evidences of uneven tempering. The sand is allowed to stand so that the maximum temper may develop. To secure this temper the sand is placed in a humidor or air tight receptacle and allowed to stand 24 hours. When removed the sample is ready to test.

After taking from the humidor, the entire sample is passed twice through a coarse riddle, the sand being returned as quickly as possible to the humidor. A sample then is taken to be tested for permeability, and for the other tests if desired. The moisture content is determined by drying 100 grams of tempered sand for one hour at a temperature between 105 and 110 degrees Cent. The sample is weighed before and after drying and the loss of weight in grams is the moisture content expressed in percentage.

A sample of sand now is placed carefully in the container *E*, and gently leveled off. From 150 to 200 grams are used, a sufficient amount to make a column 2 inches high, with a tolerance of 4 per cent. The pedestal and container with the sand in position are placed in position beneath the rammer and the rammer rod with the head is lowered gently into the container until supported by the sand. The rammer head is raised to the upper stop and let fall, the operation being completed three times. If the upper end of the rod is not within the tolerance marks, the sample is discarded and a sufficient quantity of sand is placed in the container to yield a column of the required height. After this is accomplished the rammer rod is lifted until the disk at the lower end of the rope is free from the sand container. The container then is taken off the pedestal.

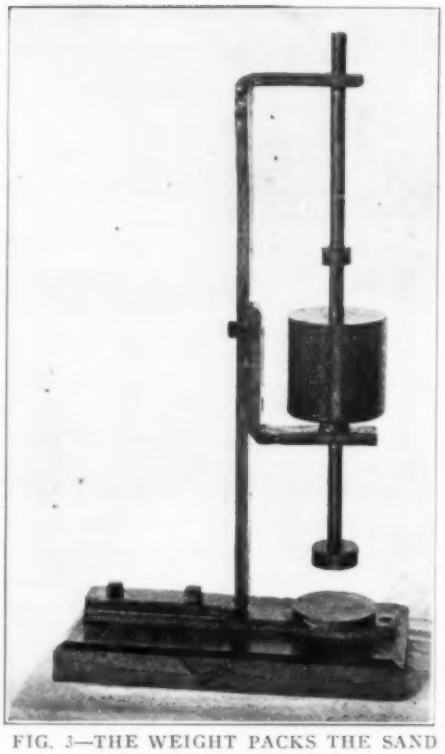


FIG. 3—THE WEIGHT PACKS THE SAND IN THE CONTAINER

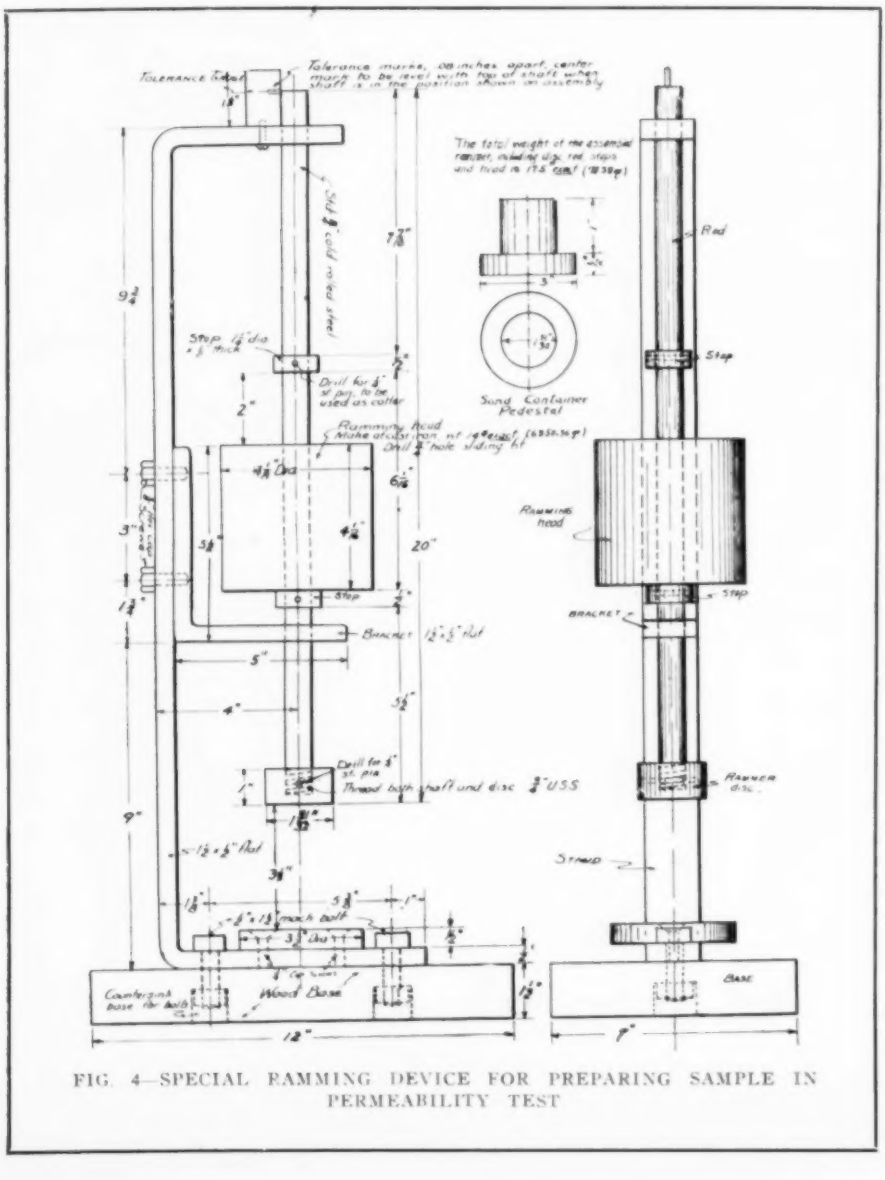

Tolerance marks, 2 inches apart, center mark to be level with top of shaft when shaft is in the position shown on assembly
Tolerance Mark
The total weight of the assembled rammer, including disc, rod, stops and head is 17.5 lbs. (7.938 kg.)
Rod
Stop
Sand Container Pedestal
Ramming Head
Make of cast iron wt. 14 lbs. (6.350 kg.)
Drill ¾" hole sliding fit
Ramming head
Stop
Bracket
Drill for ⅛" st. pin
Thread both shaft and disc ¾" USS
Rammer disc
Stand
Base
Wood Base
Counterpart base for bell
12"
7"

FIG. 4—SPECIAL RAMMING DEVICE FOR PREPARING SAMPLE IN PERMEABILITY TEST

The tank *A*, is filled with water to within 4¾ inches of the top. Before the sand container with the specimen is attached, the valve *D* is opened and the bell *B* raised until the mark *X* appears, the valve then being closed. The sand container is attached to the rubber stopper *H*, the sides of the stopper being moistened to prevent leakage of air. The valve *D* is opened and the scale on the side of the bell noted. As the cup sinks and the zero mark on the scale passes the edge of the tank, *A*, the stop watch is started. The pressure on the manometer tube is read as soon as the pressure is steady. The instant that the 2000 mark on the bell reaches the upper edge of the tank, the stop watch is stopped and the time recorded. This represents the time required to force 2000 cubic feet of air through the sand. The time and pressure thus obtained are used in determining the permeability.

The degree of permeability as determined by this test is found by employing a formula. By its use permeability is ascertained as the volume of air per minute per gram per square centimeter pressure per unit volume in the specimen. Permeability equals the number of cubic centimeters of air forced through a sand specimen multiplied by the height of the sand specimen in centimeters, and this product divided by the product of the pressure in grams, the area of the sand specimen in square centimeters, and the time in minutes. The formula used is as follows:

$$\text{Permeability} = \frac{\text{cm}^3 \text{ of air} \times \text{cm height of specimen}}{\text{x cm}^2 \text{ area pressure} \times \text{minutes}}$$

The method of conducting the permeability test which has been described calls for 2000 cubic centimeters of air to be forced through a specimen 5.08 or 2 inches, in height and having an area of 20.268 square centimeters or 3.1416 square inches. The fixed quantities therefore are substituted as constants in the equation as follows:

$$\text{Permeability} = \frac{2000 \times 5.08}{20.268 \times \text{pressure} \times \text{minutes}}$$

Reduced to the simplest terms this equation is as follows:

$$\text{Permeability} = \frac{501.2}{\text{grams pressure} \times \text{minutes}}$$

By making a slight change in the standard apparatus, which easily may be readjusted for standardization purposes, greater rapidity of operation may be secured at a slight sacrifice in accuracy. This change consists in inserting one or two standardized orifice plates in the lower end of the nipple *G*. These orifice plates must be lined with some material which does not corrode or wear rapidly. Hard gold is recommended for this purpose.

Use Two Orifices

Two orifice plates, the details of which are shown in *K*, Fig. 2 are made of brass. The plates are designed to be screwed into the lower end of the nipple *G*, which is threaded on the inner side and has the end faced square so that the orifice may fit snugly and make an air tight joint. A hole is drilled through the center of the orifice plate and is counterbored at both ends, as shown in Fig. 2. The hole in each plate is filled with a hard gold plug, through which another hole is drilled. The holes constituting the two orifices should be drilled exactly 0.5 millimeters, 0.0197 inches, and 1.5 millimeters, 0.0590 inches, respectively.

The orifices are standardized as follows: The smaller orifice plate is screwed into its place in the nipple, but the sand container is not attached to the apparatus. The weight is added to the top of the bell to give 10 centimeters pressure. The bell is raised and allowed to descend, the time required for the cup to settle from the 0 to the 2000 mark being noted. This gives the time required to pass 2000 cubic centimeters of air through the orifice which should be 4.5 minutes. If the time required is greater than this, the orifice it too small and should be reamed out carefully until it passes 2000 cubic centimeters of air in the proper time. If the time is less than 4.5 minutes, the orifice must be compressed and rereamed to the correct diameter. The second orifice, with the 1.5 millimeter opening, is standardized in the same manner, except that it should be made to pass 2000 cubic centimters of air in 0.5 minutes. Both orifices should be calibrated to within 1 per cent. The smaller orifice is to be used with medium to fine grade sands and the larger one with medium to coarse grades.

The orifice plate, which is adapted to the sand container, is screwed into its place in nipple *G*. The sand container with the sample of rammed sand is placed in position. The three way valve is turned to the place marked *vent* and the bell raised. The valve is turned to the *on* position and the bell is allowed to sink. The pressure on the manometer is read and the valve is closed. Additional samples may be tested by placing them in position on the machine, and turning the valve to the *on* position to get a reading on the manometer. The bell need not be raised again until it has sunk to rest on the bottom of the tank.

If the pressure readings are known, the permeability may be obtained from the accompanying table. The columns headed pressure give the readings on the manometer ranging from 0 to 10 centimeters. The other columns give the permeability values for the two orifices corresponding to the pressures shown. To find the permeability value of any sand from this table, the pressure nearest to that indicated on the manometer is noted. The permeability may be read in the column corresponding to the orifice used. It is possible to make a direct reading scale from the table which may be attached to the manometer, thus permitting the permeability value to be read without reference to the table.

Eggleston Supply Co., 259 Franklin street, Boston, has been made representative for Maine, New Hampshire, Vermont, Massachusetts and Rhode Island for the Hanna Engineering Works, Chicago, manufacturer of foundry equipment.

Brass Washers Split

To the Editor:

In issues of THE FOUNDRY in recent years I have observed inquiries on the causes of brass washers splitting when being faced. Some years ago I investigated this problem and found that in every case where this trouble occurred, the molder had vented the cope at the point where the opposing streams of molten metal met. The impact of the opposing streams at that point caused the metal to rise and plug the vent. The entrapped air, expanding rapidly to two or three times its normal volume, retarded the flow of metal into the mold until the air escaped through the sand. In the meantime, the metal in the mold cooled rapidly and a film of oxide formed on the surface. This caused a poor combination between the cool metal and the additional metal necessary to fill the mold, leaving a cleavage plane. That the metal did not unite properly became evident when the heat generated by the lathe tool in cutting one face of the washer expanded a part of the metal and caused a separation where the film of oxide was formed. In pouring these washers from a crucible, the cope should be vented at points about 90 degrees to the right and left of the pouring gate. When pouring from two crucibles, the cope should be vented at points about 45 degrees to the right and left of the pouring gates. Pouring should stop when metal appears in the vents.

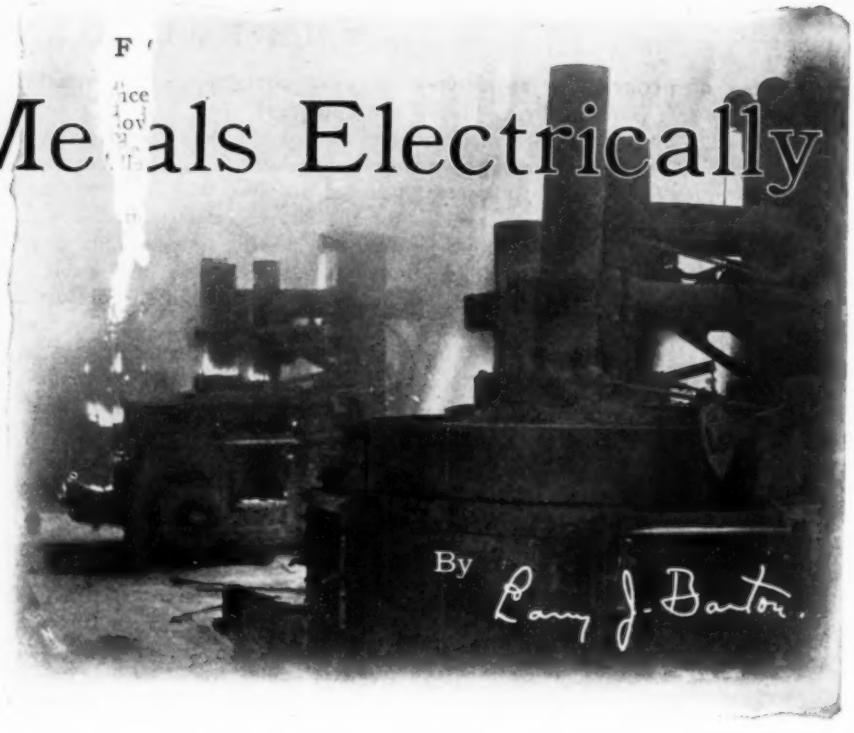
M. M. MORRISON,
Calumet & Hecla Consolidated Copper Co., Calumet, Mich.

Lectures on X-Ray

"Crystal Structure and its Applications" was the subject of 12 lectures given before the graduate students of Pennsylvania State college during July by Dr. Wheeler P. Davey, research laboratory, General Electric Co., Schenectady, N. Y. In the lectures both the theory and application of the x-ray analysis methods to chemistry and metallurgy were considered. Dr. Davey has been prominent in the development of the x-ray crystal analysis apparatus, and is the author of a number of papers on the subject.

The Wm. F. Hartig Plow Co., Evansville, Ind., has sold its plant and factory site and now is engaged in building a new foundry. The company has discontinued the manufacture of plows and will devote its entire capacity to gray iron castings including gas engine, stove work and special water heating equipment.

Refining Metals Electrically



Chapter II (Continued)

Completing Rammed Hearth —Type of Bottom Is Important

THE hearth being rammed to shape in the manner described in the previous installment, and the walls banked, the roof is set and the furnace is ready for drying. As there is no objection, under this method of bottom making, to contaminating the hearth, wood may be used for this drying operation. Wood is recommended as the greatest part of the heat obtained from a bed of hot coals will be thrown where most wanted, directly into the rammed sand. A small fire is started directly in the center of the hearth, and kept going until gradually a fair bed of coals is obtained This generally takes 3 or 4 hours, when the roof and side walls will be thoroughly dried. The fire now may be increased rapidly until a bed of coals 6 or 8 inches thick is obtained, distributed evenly over the hearth, and up along the banks as high as possible.

This bed of fire is maintained until the bottom shell of the furnace begins to feel hot to the hand. On a 3-ton furnace this will take generally 10 to 12 hours, assuming that the depth of hearth is about 15 inches. Coke, in lumps about the size of your fist, then is shoveled in, being mixed with more wood. This procedure is followed until a bed of red hot coke not less than 4 inches thick is obtained. By this time the furnace shell will be so hot around the sides and underneath that it is almost impossible to hold the hand against the steel plate. This means that absolutely all moisture has been dissipated, and it is safe to proceed with the actual baking.

As silica is readily reduced by coke at high temperatures, the heating must be kept below the point of reduction or the result will be a hearth containing spots of partially reduced sand which will melt out rapidly under the influence of steel, and absolutely ruin the hearth, or at the least form badly pitted spots. All that is necessary is to keep this bed of coke at a good white heat. If there is any tendency to overheat, the current may be shut off and the furnace allowed to soak. Watch the edge of the jamb bricks and at the first sign of glistening, turn off the power until the brick cease shining.

Ordinarily when the power is first turned on it is held for about two hours, or until the bed of coke is dazzling white. The procedure then will become intermittent, shutting down for about 15 minutes, then under power for about the same time. This period of heating will take from 6 to 8 hours, when the hearth will be baked sufficiently to be ready for steel.

The power then is turned off and the coke and ashes raked out by tilting the furnace and using rabble bars. If possible a heat should be made immediately that the hearth may be finally set before cooling down. The first heat should carry a large volume of slag which should be splashed heavily on the walls to tend to bind in the rammed banks.

The spouts and portions of the walls and bottom around the doors under basic practice are repaired in a manner similar to that described under basic practice, with the exception that sand is used instead of magnesite. The sand is made into a heavy mud and plastered to shape with a trowel. Any good binder is satisfactory for this purpose, sodium silicate being preferable due to its cheapness, and ability to set in a few minutes. Ordinarily, the spout will have to be cleaned out every few heats, as slag gradually builds it up to a point where the metal will not drain completely. It may be placed in shape and dried out for half an hour with a light wood fire when it is again ready for steel.

In acid furnaces rammed linings are used to some extent, especially in furnaces up to 2 tons in size. The exponents of this practice claim cheapness, and ability to patch quickly as the main assets. The writer has tried this method several times, using different patented cements, the test being made to prove the manufacturers claims. While the rammed lining is satisfactory, it is not cheaper than one of brick. It will not give the same length of service. It takes longer to lay, and must be more thoroughly dried out than a lining of silica brick before going under the arc. Further, it is more likely to crack and shell badly, often failing when least expected.

It is advisable, when shipments of

Hearth Types Noted

THROUGH a series of experiments, the author develops data on various shapes of hearth linings. The deep, bowl-like section proved to be the most rapid melting, but other considerations led to the recommendation of a modified contour with a sharp slope close to the walls. These experiments and their results are outlined in this installment of Mr. Barton's writings. The various considerations governing thickness of side walls, some points on the care of electrodes, and the size of heats for economical operation will be covered in the next article of the series, which will appear in an early issue.

Table [illegible]

Log of Bottom Bu[illegible]ng Acid Lining

THREE TON 'LE[illegible]LT FURNACE

TWO courses of clay brick were laid next to the shell, being mudded into place between the hearth connections, which were sheet iron strips set at regular intervals over the bottom. After the clay brick had set these strips were flattened down and two coats of thin clay slurry swept over to fill the cracks between, and bond the brick together.

In making the mixture for this hearth, a patented refractory cement, was used exclusively. Although the cost of this mixture was rather high the furnace was installed to operate under severe conditions ,and it was thought that the best possible hearth construction would be the cheapest in the end. This hearth was in steady operation for over a year with absolutely no trouble from the bottom.

As the furnace was placed in operation before the sand mill had been installed, it was necessary to mix all refractories by hand. Three wheelbarrows of the best silica sand was mixed at a time, the high temperature cement being made into a thin slurry, and mixed with the sand until a handful squeezed would just bond itself, similar to a properly prepared molding sand. As soon as one batch of this san[illegible] prepared, a section of the hearth along one side was painted with the cement slurry, and the sand immediately shoveled in over this spot. An air rammer was used to ram in the refractory, the hearth being rammed as hard as possible. This operation was continued until the entire hearth had received a layer approximately 1 inch thick.

The bottom gradually was built up in this manner until about 15 inches thick in the center, leaving a hearth of approximately 5 tons capacity. After ramming was completed the bottom was as hard as the silica brick wall. A mixture of sand and sodium silicate then was made, the furnace tilted over as far as possible, and this mixture laid up along the side walls to the roof, both on the front and back walls. All rammed materials then was given a coat of sodium silicate and allowed to stand for about half an hour.

After the roof was set and cemented in place, a small wood fire was started in the center of the hearth. This was lighted about 1:00 p.m., and allowed to burn slowly for two hours.

FIRST DAY

3:00 p. m.
Fire slightly increased, several large pieces of heavy timber being added. Roof and walls rapidly drying out and heavy stream of steam issuing from around doors and roof.

4:00
Steam gradually dying down and a good bed of coals building up over hearth. Fire kept going steadily until a roaring flame was produced.

5:00
Side shell of furnace getting warm, especially around roof ring. Roof gradually taking up expansion and becoming hot. This fire kept going steadily until 8:00 when about two inches of coke was spread evenly over the hearth, and the doors opened slightly to allow an entrance of air into the furnace sufficient to support combustion. When this had become ignited thoroughly another light layer was added. This was continued until the bottom shell of the furnace was so hot the hand could not be held against it. In about another hour the entire shell was in this high temperature condition.

SECOND DAY

6:00 a. m.
Electrodes lowered and arc struck. Low voltage side of transformer used, and gradually raised to 4000 amperes as soon as furnace would take the load.

7:00
Bed of coke white hot, and edges of door jambs slightly glistening.

8:00
Jambs beginning to run. Current shut off and furnace allowed to soak until 8:30 when current was again turned on.

9:00
Shut down for 15 minutes, then on for 15 minutes. This operation continued until 10:00 when power was finally turned off and hearth was ready for steel.

Electrodes were raised and hearth cleaned out with hoes and rabble bars, when the furnace was immediately charged for the first heat. The actual amount of power used in the burning operation was 1000 kilowatt hours.

brick are delayed or where the operations are so intermittent that it is too costly to keep a stock of brick shapes on hand to resort to a rammed lining. For furnaces under 1 ton in size, where operations are continuous or nearly so, a rammed lining will give excellent service for the reason that it becomes coated with slag and is never allowed to cool down enough to crack or spall off when reheated.

The method of building a side wall is similar to making the hearth. A wooden form is constructed, usually in sections, of the proper shape and size to give the thickness of wall desired. This is placed in the furnace and the refractory material rammed between this form and the furnace shell. The mixture is made exactly like that used for the bottom, and is well rammed into place, a little at a time. The same precautions must be observed here as for the hearth, that certain binders will work only under steady operations, while others are satisfactory under varying practice.

After the entire wall has been built to shape, it is allowed to air set for several hours, when the form is removed and the furnace thoroughly dried out. In some cases a rough form is constructed which is allowed to remain in place, being burned out when the furnace is undergoing its drying operations.

A rammed wall may be strengthened by inserting gaggers and ramming around them, but this must be watched carefully or the metal, due to its greater expansion will cause the refractory to crack.

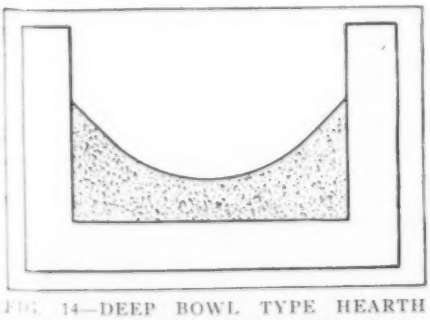


FIG. 14—DEEP BOWL TYPE HEARTH IS CONDUCIVE TO RAPID MELTING

Hearth Shapes Important

HAVING noticed at various times that differences in speed and economy of operations were obtained with hearths of different shapes, a series of experiments were conducted to determine, if possible, exactly the results occurring from such differing conditions. Experiments on basic practice were made on a standard 6-ton heroult furnace, operating over a 24 hour period, and engaged in the manufacture of steels for castings, forging and rolling ingots.

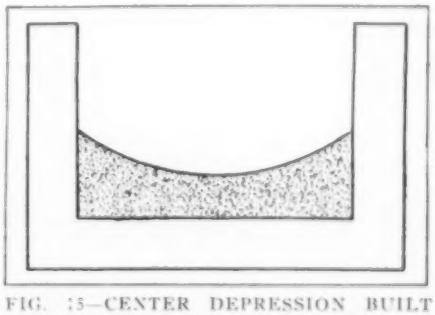


FIG. 15—CENTER DEPRESSION BUILT UP TO GIVE FLAT TYPE HEARTH

Table XVII

Bottom Sand Analysis

Locality	Silica	Percentage Oxides	Lime
Alabama	87.80	4.90	4.00
Illinois	95.00	1.48	3.08
New York	97.78	1.73	.61
California	80.00	12.15	2.05
California	86.26	8.57	1.46
Chicago	88.89	5.67	.99
New Orleans	94.30	4.20	1.00
Colorado	83.30	13.40	3.25

The hearth as first put in was of the shape shown in Fig. 14 being 8 inches thick in the center, the walls being run up as high as possible. After carefully following results on this hearth we allowed the bottom to build up, by charging lime on the hearth, to the shape as shown in Fig. 15, with a depth of 12 inches in the center, the contour being rather shallow and flat. When the figures from this were sufficient to prove the results, we cut the hearth down to the shape shown in Fig. 6, by the judicious use of finely ground fluor spar. During the entire examination conditions of operation such as size of charge, character of scrap used, class of metal made, temperatures of pouring, etc., were kept as alike as possible.

The type of bottom illustrated in Fig. 14, held a charge of from 6½ to 7 tons without banking up the doors. Of all the shapes it melted down the most rapidly, probably due to the fact that the charge is more or less centered under the arcs, the walls being steep enough to allow for the automatic centering of the scrap as it melts down and falls into the bath.

It took this hearth longer to heat to the depth of metal under the arcs. For the same reason, refining was not as good as the type shown in Fig. 16, the effective slag area not being as large.

Trouble was experienced with the arcs cutting the banks opposite each electrode, due to the nearness of the wall to the point of the arc. The increased depth of this hearth required a greater length of electrode between the roof and the bath during melting down. For this reason, the holders must be fastened higher up on the electrode, which resulted in a greater surface exposed to the heat, and during refining, the air, which raised the electrode consumption.

The shallow hearth shown in Fig. 15 would hold only from 5½ to 6 tons of metal per charge, and proved of no value at all in view of the figures from the other two shapes. It took greater power, more time per ton, more electrode consumption in proportion, to turn out these smaller heats than it did with the larger tonnages on the other bottom.

The bottom of the type shown in Fig. 16 proved to be the best shape for the existing conditions, the only difficulty being to keep it to shape, the tendency being to build up to the shallow hearth. This was overcome by sand and fluor spar and finally it was found possible to hold its shape more easily. While this type bottom did not melt as fast as the one first noted, the time per ton was less, due to a shorter time of refining and superheating. No trouble was experienced with the side walls, and refining, due to the large slag area, was possible without extra trouble, down to as low as 0.005 per cent sulphur.

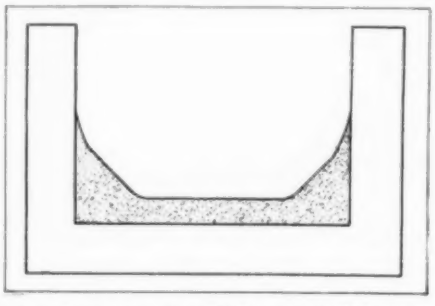


FIG. 16—TYPE OF HEARTH DIFFICULT TO MAINTAIN BUT HIGHLY EFFICIENT

With the hearth of the type shown in Fig. 16, it was found possible to melt and pour 8 tons of metal, in the same time as would take for 6.5 tons of that illustrated in Fig. 14, or 5.5 tons in the one like Fig. 15. On this bottom many 8-ton heats for steel castings were made, using the two slag process, in as short a time as 3 hours 5 minutes from the time current was on until pouring.

Experiments similar to the foregoing were conducted for a furnace operating on the acid hearth, the equipment used being a standard 3-ton 'Lectromelt. This furnace is built to use an exceptionally thick hearth, the normal depth of refractory being about 18 inches for a rated charge.

The hearth was first placed in operation with a 15-inch refractory thickness, being constructed to carry 5-ton heats. The shape was as shown in Fig. 14, with the exception that the banks were built completely to the roof, giving a deep bowl effect. After several months' operation, the hearth was allowed to build up about 3 inches so that the doors had to be banked for

(Concluded on Page 652)

Table XVIII

Log of Bottom Burning Acid Lining

TWO TON GREENE FURNACE

ONE layer of clay brick was laid on the flat over the bottom shell, and the walls bricked up. The hearth was built of a good grade silica sand mixed with glutrin as a binder, the bricks being well painted with the cement before the sand was rammed.

The hearth was built to a depth of 10 inches in the center, and extended up the front wall to the roof. The rammed material was placed about half way up the back wall. A small wood fire was started and gradually increased over 10 hours until the furnace shell was hot, when coke was shoveled in, sufficient being added to form a layer about 6 inches deep.

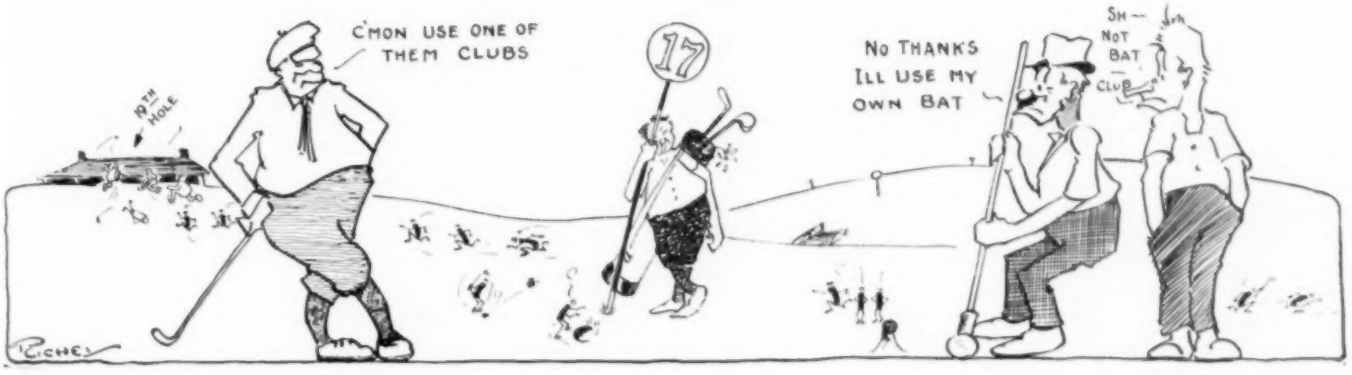
In about half an hour, this coke was incandescent and the arc was struck. In two hours the furnace was extremely hot, when the current was shut off and the furnace allowed to soak for half an hour. The power again was turned on and the furnace allowed to run for 15 minutes, then shut down for 10 minutes, and this procedure was repeated. After the current had been on for 5 hours, the furnace was ready for steel. This hearth gave fair service, but later was found subject to slight chipping.

A similar hearth was made using sodium silicate as a binder. Excellent results were obtained as long as the furnace could be kept on a moderate production basis, operating at least 3 heats a day or better, sufficient always to keep the hearth fairly hot. However, as soon as the hearth was allowed to get dead cold, trouble started. The hearth on cooling would tend to crack badly, and later crumble along this line of severance, requiring patching after each shut down, causing much unnecessary labor and delay.

The hearth was removed and one made of a prepared refractory cement and sand used, which gave excellent results under any conditions, the cement having the ability to bond strong enough to prohibit any possible crumbling or flaking.

Bill On How and Why Molds Are Stacked--IV

BY PAT DWYER



MANY pride themselves on the ability—or perhaps I should say the agility—they display in resisting temptation. They pat themselves on the back, figuratively speaking, and cheerfully announce to all who care to listen—and to others who through force of circumstances are obliged to listen—that the struggle at times is long and bitter, but their indomitable will enables them to say NO.

I have been tempted severely in recent years to take up golf or some other form of equally harmless outdoor exercise with a view of developing and retaining a sylph-like figure. Up to the present I have experienced no difficulty in manfully resisting the temptation. I do not say this in a boastful spirit. Neither do I claim credit for the possession of a firm and inflexible will. Not at all. It is a gift. One of these intangible and precious attributes through which a man is enabled to retain his hair, his temper and his ability to appreciate three meals a day, spaced at judicious intervals, and a bed on which to sleep at night under the soothing influence of a clear and sparkling concience.

I am not a crank on the subject of exercise. I can take it or leave it alone and I have not the slightest objection to seeing others indulge in it even to the point of exhaustion. Happiness after all is a state of mind and if a sun burned skin and a set of aching muscles make a man happy, I am sure I would be the last person in the world to stand in his way—or envy him. I feel more like saying to myself "God help him and all others in a like lamentable condition. He is easily pleased!" We have had many arguments in our house over this subject and although I cannot concientiously say that I have convinced the party of the second part with the soundness and sterling logic of my views, still in all modesty I think I may claim that I have held my own.

Recently the mailman left a pamphlet at my modest cot which for a time almost convinced me that unless I changed by mode of living to a radical extent I faced a short and dismal future. The treatise was issued by a gentleman who conducts a gymnasium and physical culture service station. I gathered in a general way that this eminent citizen was actuated by purely philanthropic motives and by an overmastering desire to assist his fellow men in their inalienable right to a long life, liberty and the pursuit of happiness.

On the face, the proposition appeared quite simple. The more one exercises, the longer one will live. The longer a man lives, the more time he has to exercise. Simple says you. That's the word and you may lay to that. One of the good old vicious circles so familiar a few years ago, but which apparently have gone into retirement, like all things pass after they have been worked to death by the philanthropists who furnish us with our opinions and our conversation.

A portrait of the benefactor adorned the cover of the book. His manly form was shown practically naked and in the text which appeared on the first inside page, attention was directed to the bumps which adorned his arms and legs. The reader was informed that these unsightly knobs were muscles which had been developed through a special course of sustained and systematic training. The statement was not made in so many words, but a careful perusal of the context in the succeeding pages led one to infer that the *tout ensemble* represented the ideal male figure. Modern, peppy and all that kind of thing as became an up-and-coming young business man, but also retaining all the features which rendered pre-historic man such a success in his prowling expeditions. Thewed like an Auroch bull and all that kind of thing. When I showed the picture to Bill and directed his attention to some choice bits from the accompanying text, he rose to the occasion in his usual competent manner and declared the bird was a regular WOW!

It may be that I have not the true artistic eye and therefore cannot appreciate the Beautiful, but I confess that a human figure built on what is known in the automobile trade as a stream line model appeals more to whatever rudiments I may have of the artistic sense. I am sorry to say that instead of admiration, the figure appealed to my sense of the ridiculous. It reminded me of an experience I had in my youth when I suffered from a consuming desire to be a naturalist and when I had attempted to skin and stuff every furred and feathered creature that came within the range of a trustly little .22 caliber rifle.

I easily mastered the technique of removing the pelt, but I am afraid their own mothers would not have recognized the figures of some of their offsprings after I had packed the skins full of cotton wool, sewed them up and adjusted them in an impossibly life like position with the wires through their feet clinched through a board or the branch of a tree. Naturally, as the creator, I viewed the monstrosities with a tolerant and prejudiced eye, but I reluctantly had to admit that ex-

THE MAIL MAN LEAVES A PRIZE

cept in a general way, they bore little resemblance to the originals. They were correct mathematically in that they presented the proper number of eyes and ears, their tails were in the proper geographical position and their legs never exceeded the usual quota, but somehow they seemed to lack something. They were not convincing. Only for the labels which accompanied each figure I would have been at a loss at times to identify the various specimens. Strangers, of course, seeing them for the first time invariably insisted that I had misplaced the labels. My most pretentious effort was a little fox terrier which in life had been the cherished companion of a boy friend. The dog died and for a limited period the friend was heart broken. While in this state and therefore not in a condition to realize what he was doing, he begged me with tears in his eyes to remove the hide and stuff it for him. I did so and reaped the usual reward of the disinterested friend who does any person a favor. The lad refused to speak to me for nearly two years.

After I had removed the skin and disposed of the *corpus delicti* with the exception of the skull which I boiled to remove the flesh, other important duties claimed my attention for several days. When I finally attempted to drape the skin over the cotton-wrapped wire frame I had prepared, I discovered it was about as soft and pliable as a sheet of stiff cardboard.

The thing certainly was a sight when I finally stitched up the opening and fastened the feet on a board. I am sure it resembled nothing in the heavens above, the earth beneath or the waters under the earth. My most friendly critic said it reminded him of something that had been blasted out of a quarry and I would not like to say what other less friendly spectators said about it.

The eyelids had contracted to such an extent that I only succeeded in getting them half open and the resulting expression conveyed the impression that the animal was feeble minded and did not know whether he was coming or going—kind of silly, if you know what I mean. The ears had stiffened straight out from the head in a horizontal position while the tail stuck straight out behind and resisted all my efforts to give it a graceful bend. The skin refused to lie close to the packing I had placed inside and instead of a nicely rounded figure, the body resembled one of these things which the late Mr. Euclid feelingly described as an irregular polygon, all humps and sharp corners.

WHERE, OH WHERE HAS MY LITTLE DOG GONE

While Bill was present the other night I requested his opinion on the subject of exercise with special reference to the game of golf. "Well," said he, "I'll tell you. Exercise is all right in its place, but the same form of exercise will not suit all men. Many factors have to be taken into consideration in the same manner that local conditions must be taken into consideration in adopting the most suitable method for stacking molds. On former occasions I have described three methods and since we have a minute to spare I may as well say a word or two on the fourth method.

"For several reasons the fourth method for stacking molds is not so familiar to foundrymen, and therefore is not practiced so extensively as the others. That statement may be read either way. It has the same meaning whether the first clause is read second or first, but since we are not here to waste our time arguing over technicalities we shall let it stand in the original form and hop along on our way. Do you follow me?"

"Follow you," I said. "Say, you remind me of an old pedantic boss patternmaker I knew at one time. That was one of his favorite sayings, 'Do you follow me?' He spread a drawing in front of one of his gallus young apprentices one day and started to explain it to him. The drawing was fairly simple and the young lad's scanty stock of patience was exhausted long before old dry-as-dust had proceeded half way through his explanation. His nimble mind had grasped the salient points after he had taken one good eyeful. At about the fifteenth 'Do you follow me?' he exploded. 'Follow you?' said he. 'For heaven's sake, take a hurdle or two. I am about six laps ahead of you right now!'" "My mistake," said Bill. "If I had been addressing a clever young second year apprentice I would have made allowance for the fact that his knowledge far exceeded mine and would have been careful not to lay myself open to his ridicule. I assumed that you were a fairly intelligent person with a sufficient knowledge of the foundry to realize that only a comparatively small number of foundrymen know all that is to be known about the business. At one time or another I have met eminent members of the profession and without exception they admit there are still a few points on which they would appreciate further light. However, as I said before nothing is to be gained by arguing over technicalities. A good argument has its compensating features occasionally, provided the party of the second part holds to his course, but when he persists in dragging red herrings in by tail and otherwise violating all the rules of the game it is time either to call a halt or grab a club. Usually clubs are trumps.

"That argument you advanced a few minutes ago is in the same general class, one of the offsheets you might say, as the old familiar problem: Which came first, the hen or the egg. In all probability millions of words and millions of precious hours have been wasted in a

TAKING A LITTLE PRELIMINARY CANTER OVER THE BUNKERS BEFORE STARTING THE USUAL DAY'S WORK

vain endeavor to settle that point definitely since man first arrived at a stage where he was competent and qualified to carry on an argument without a club or a hunk of a granite boulder. The point at issue never has been decided and although I do not set up for a prophet and make no claim that I am descended either from one prophet or a long line of the same profession, I am willing to stake a modest wager that it never will be decided. Anyway, what difference does it make. What difference did it ever make, and, dearly beloved brethren, if we consider the problem on a purely utilitarian basis, what possible effect will it have on the price of eggs? Stick your fork in that omelet, me lad, while you are resting yourself. The method of stacking molds I had in mind involves the use of more elaborate molding machines and pattern equipment than any of the others to which I have referred and probably that is the reason why foundrymen have not regarded it with more favor or adopted it more universally. At least one American and one German machine have been developed for producting part of the pattern impression in the cope and the remainder in the drag. That expression is hardly explicit enough. Perhaps the meaning would be clearer if I were to say that the two impressions are produced simultaneously in each single flask part. In this method the usual and recognized method of producing a mold is reversed. Thus the impression produced in the sand in the under side of the flask as it sits on the machine forms the cope of the completed mold. The impression produced in the sand on the upper side of the flask at the same time forms the side of the following superimposed mold part.

"Two pattern plates are employed, one forthe top and one for the bottom and the flask is squeezed between the two. In other words the upper pattern plate serves as a squeezing head and when it is removed it leaves the impression of a certain part of the pattern in the sand. It is apparent that to secure satisfactory results with this machine, all the flask parts must be interchangeable and machined accurately.

"As an example of the efficacy of the machine I might say that I have seen one in operation in a prominent agricultural foundry in the middle west where one man and a helper put up, poured and shook out 880 plow points every day. The machine was equipped with two patterns and the molds were stacked 8-high for pouring. When I was a boy I can remember working in a little jobbing shop where 22 flasks with two patterns in a flask was considered a good day's work. For all I know to the contrary it is considered a good day's work in that locality even today.

"The molding machine has revolutionized the foundry industry, particularly where large quantities of repetition castings are made from day to day. However, even under the most favorable conditions and with improved types of machines that are continually becoming more fool proof and automatic in operation, the human factor still plays an important part. In the particular case I have cited only one man has been found who could operate the machine to capacity. Other men have been tried from time to time, but none ever has equalled the record set up and maintained by this particular operator. In another part of the same foundry some 30 molders working individually each with a plain type squeezer machine put up floors of between 275 and 300 plow points, that is from 550 to 600 castings for each pair of men and the output is considered satisfactory.

"This instance illustrates one of the many reasons why the multiple molding machine is not adopted more extensively, especially in foundries that have been operating for a considerable period of time. The workmen are accustomed to one type of machine and are able to produce castings that may be disposed of profitably on a competitive basis. The machines, flasks and pattern equipment represent a considerable capital investment. Any change from one method to another would entail scrapping of the patterns and flasks. The machines while practically as good as ever would only bring second hand prices in the open market. In addition to these features a considerable loss in production would be involved while the operators are getting accustomed to the new type of machines. All these factors tend to make a manufacturer cautious and play safe in the well known belief that it is better to let well enough alone."

"It seems to me," I said, "we have drifted a long way from the subject of golf and golfers. Do you know anything about the game or have you just been talking about something else with a view of stalling along and concealing your ignorance?"

"That's rather a neat shot," said Bill. "To tell you the truth I know no more about the game than the young lady who admitted that she did not know which end of the caddy to use. Judging by the number of golf courses in existence and by the number of people constantly rushing hither and yon with bags of golf tools over their shoulders, there must be some kind of fascination connected with game. I will not go so far as to claim that all those who carry bags are golfers, but even allowing for the usual 25 per cent of bluffers, the number is fairly high. I heard recently of two men strangers at first, but bound together by mutual attraction before they had gone around the course. On parting for the day, the elder man said: 'Eh, lad but yon was a graun' game the day. Let's hae anither yin the morrows morn.' The young man thoughtfully stroked his nose. 'Well,' said he, 'I'll tell you. I had planned to get married tomorrow morning, but I suppose I can postpone it to a more suitable occasion.'"

Faked Foundry Facts

Poured Short

Elect New Officers

At a recent meeting of the Moline Iron Works, Moline, Ill., reports read showed the year ending June 30, 1924, to be the best in history for the malleable iron foundry of that plant. The following officers were elected: President, L. E. Nutt; vice presidents, B. V. Nutt, M. C. Nutt; treasurer, J. T. Miles; secretary, L. H. Dorman; directors, Wm. Butterworth, L. H. Dorman, Sol Hirsch, J. T. Miles, D. E. Miles, L. E. Nutt, B. V Nutt, M. C. Nutt and C. R. Rosborough

The Weir Stove Co., Taunton, Mass., has reincorporated as the Glenwood Range Co. This change was made to conform with the name of its product, which it had been making for many years. So far as can be learned, no other changes were brought about by the new incorporation.

How and Why in Brass Founding

By Charles Vickers

Pinholes in Castings

We are experiencing considerable trouble arising from pinholes in bronze bushing castings. The alloys are melted in a coke fired furnace, and consist of ingot metal of such composition as 80 per cent copper, 10 per cent tin, and 10 per cent lead. The walls of the castings are from ½ to 1 inch in thickness, and their weight ranges up to 30 pounds. Can you tell us how to avoid this difficulty?

Sometimes pin holes in castings may be eliminated by the addition of phosphor copper to the mixture. About 4 ounces of phosphor copper containing 15 per cent phosphorus will be sufficient for 100 pounds of ingot. The latter is, of course being melted in crucibles as coke-fired furnaces are used, and this permits the use of charcoal as a covering while the metal is being melted. Do not be too economical with the charcoal, and do not permit some of the ingots to be placed on top of the coke fire to get heated thus causing them to melt quicker. This is quite unnecessary and if a deepener is placed on top of the crucibles, all the ingots comprising the charge may be placed in the crucible when it is first filled up.

In case the phosphorus fails to eliminate the holes, add 2 per cent of zinc and deduct this from the copper. The zinc will do no harm to the 80-10-10 mixture for bearing purposes and it usually greatly assists in getting sound castings. It now is being added to leaded alloys for that purpose by many foundrymen.

Die Casting Methods

One of our customers wants castings made in die molds and we do not know the process. We will appreciate your advice as to how to proceed, and what results may be expected to eliminate machine work. The casting is a tube 3½ inches long, 1⅞ inches diameter, and ¼-inch in thickness. It consists of three parts and has a step in the middle. What amount should be allowed for shrinkage and is it necessary to graphitize the mold, and should the latter be made of cast iron, chilled?

As it would be foolish to employ the die casting method of making castings unless a product was turned out greatly superior to what is possible in sand, it becomes necessary to have a finely finished mold, or *die* and this may only be made by a professional *die sinker*. Such a *die* would cost several hundred dollars, which would only be a beginning. Since the die has to be manipulated with speed and certainty it cannot be held in the hand during use. This necessitates another expense, a machine for operating the die being required, which costs several hundred dollars more. Ordinary brass foundry alloys, such as red and yellow brass, cannot be used in the die casting process, aluminium bronze being required. The aluminum bronze must be handled from small crucibles in the case of small castings, and small crucibles need small furnaces, together with the equipment for handling them and the crucibles, and this means another large expense. Taking all these things into consideration, the expense or investment might reach into four figures easily. Then, the business of making die castings must be learned, and there are people who have found this exceedingly costly. If the castings in question have to be made in quantities of hundreds of thousands, the best way to proceed will be to get figures from die casting concerns already established, as it is a line of business with which no small brass foundry may afford to experiment.

Making Yacht Fittings

We have some fittings to make for use on a yacht and it is necessary to make them of a white brass. The alloy must be strong and also take a polish.

The following alloy will prove satisfactory:

WHITE BRASS

	Per cent
Copper	58.00
Nickel	16.00
Lead	2.00
Tin	1.00
Zinc	23.00

It will be noted the above alloy is a good casting yellow brass with sufficient of the copper replaced by nickel to make it white in color.

It is advisable to purchase an alloy containing 50 per cent nickel, 50 per cent copper to avoid melting difficulties to add the nickel. If the alloy fails to run freely, flux it with 1½ ounces of aluminum for 100 pounds of alloy.

Pure Copper Castings

We have an enquiry for pure copper castings which are expected to machine clean. Our experience with copper is limited. We have made a few castings but they have a dusty appearance on the outside, and the inside when machined appears to contain specks of charcoal, although we are particular about charcoal going over with the pouring stream. Can you advise us in regard to the best way to proceed to make such castings?

Copper castings are of two kinds, namely those extremely pure and those that may contain from 5 per cent down to one quarter of one per cent impurities. The first class of casting only are entitled to the designation *pure copper castings,* and they are used in connection with electrical apparatus. The second class of copper castings, *mechanical copper castings* are used where copper is specified, but where extreme purity is nonessential.

Any founder who has learned to make the first class of copper castings, may make the second class also, but it does not follow from this, that makers of the second class of castings may make the first class. In fact they seldom make the first class castings. Therefore, it will pay to learn how to make the high grade castings.

A copper alloy, invented by the writer is now on the market, has been used for five years successfully in the production of high electrical conductivity copper castings, and instructions for obtaining it are enclosed with a copy of this answer.

The second class of copper castings may be made easily by the addition of three per cent zinc. The dusty appearance of the castings mentioned in the query is due to the presence of silicon, probably too much being used. An alloy containing 90 per cent copper, 10 per cent silicon is quite sufficient to produce sound copper castings of low electrical conductivity. Also, if casting copper is used, it may contain a little lead, which with the silicon would produce this dusty appearance. To make copper castings, it is necessary to use electrolytic ingot, not only for the first class of castings, but for the second class. Regarding the black specks we are unable to advise without an analysis of the copper, and a knowledge of the manner in which it is being melted under your present operating conditions.

Glue Used in Patternmaking

Best Practice Must Be Employed To Keep Patterns from Warping and Coming Apart—Tests Conducted To Determine the Strength of Glued Joints—Glue Must Be of Good Quality

BY WALTER C. EWALT

GLUE perhaps is next in importance to wood among the supplies needed in the pattern shop. The majority of good patterns are made without nails, screws or other metal fasteners, glue being used to hold the pieces of wood together. Gluing pieces of wood together to secure strength and prevent warping is one of the first principles employed in patternmaking. This subject should be thoroughly mastered since the life of the pattern is lengthened greatly by employing the best methods. It is disagreeable and often costly to repair patterns that have warped out of shape, due to improper gluing. Many times the damage is caused by using poor glue or by having the grain of the wood laid the wrong way. For this reason it is of extreme importance that glue of the highest quality be used in patternmaking.

Gluing should be done in a warm room and the wood being glued also should be warm. The glue must be thin enough to spread on easily, but not too thin since it will lose its adhesive properties. The glue must not be too thick, since it will prevent the pieces of wood from coming together tightly, thus leaving a thick joint of glue which soon will part. Heavier or thicker glue may be used on pine wood than on the hard woods, since the heavier glue enters the larger pores of the softer woods.

Animal Glue Used

When a good joint is made, the wood of one piece comes in contact with the other piece of wood, the theory being that the most of the holding is done by the glue in the pores. Most glue used in patternmaking is animal glue, which is obtained from animal tissues containing an adhesive substance. This is changed by boiling into a substance called gelatine. The gelatine obtained from the different parts of the animal tissue has various names, that obtained from the bones, hoofs and hides being called glue. A good way to test the adhesive qualities of the glue is to place a small amount of it, when hot, between the thumb and second finger, and as it cools it should form strings or threads as the thumb and finger are extended. As an experiment, the author took the lid off a can of liquid glue. Some of the glue was attached to the lid, and the author walked 30 feet before the strings broke.

Glue should harden from 2 to 12 hours, although in rush jobs it has been worked sooner than that. However, considerable chance was taken that the pattern would come apart. As a general rule, four or five hours is sufficient for good glue to set. The length of time necessary may be determined by experimenting with different types of wood, allowing various lengths of time for the glue to set. The adhesive strength also may be determined by splitting the small glued pieces. If the glue is of good quality, properly prepared and applied, the pieces will adhere so closely that the fibres of the wood will tear apart before the glued surfaces will separate.

Test Glued Surfaces

A test recently was made to determine the strength of various pieces of wood when glued. Sixteen pieces of wood, eight pine and eight cherry, were turned to 2 inches in diameter and 4 inches in length. These pieces were glued together at the ends, making eight test bars, the test bars and methods of gluing being shown in Fig. 1. With the exception of bars Nos. 1 and 8, the bars were made differently, either in the kind of wood used, or the position of the grain of the wood.

The author was led to make this test because of an experiment that had been made on two pieces of ash, 1½ inches in diameter. The pieces were glued together, and after drying 24 hours, it required a force of 1260 pounds to separate them. Consequently the force of adhesion was equal to 715 pounds per square inch. The results of the test did not give the direction of the grain when the pieces were glued. Only one stick exceeded this strength in the test conducted by the author. The difference in the results obtained was so great that a workable average could not be obtained. Further tests should be made similar to that shown in Fig. 1, to get a more correct average.

Some peculiar things happened in the test. A difference of 802 pounds per square inch was found between Nos. 7 and 8. No. 1, which was end grain of pine glued to end grain of cherry held 51 pounds more than No. 3 which was end grain of pine glued to end grain of pine. This would indicate that the cherry wood may have had something to do with the added strength of No. 1, but the author believes that the joint at No. 3 was not as well made as that at No. 1.

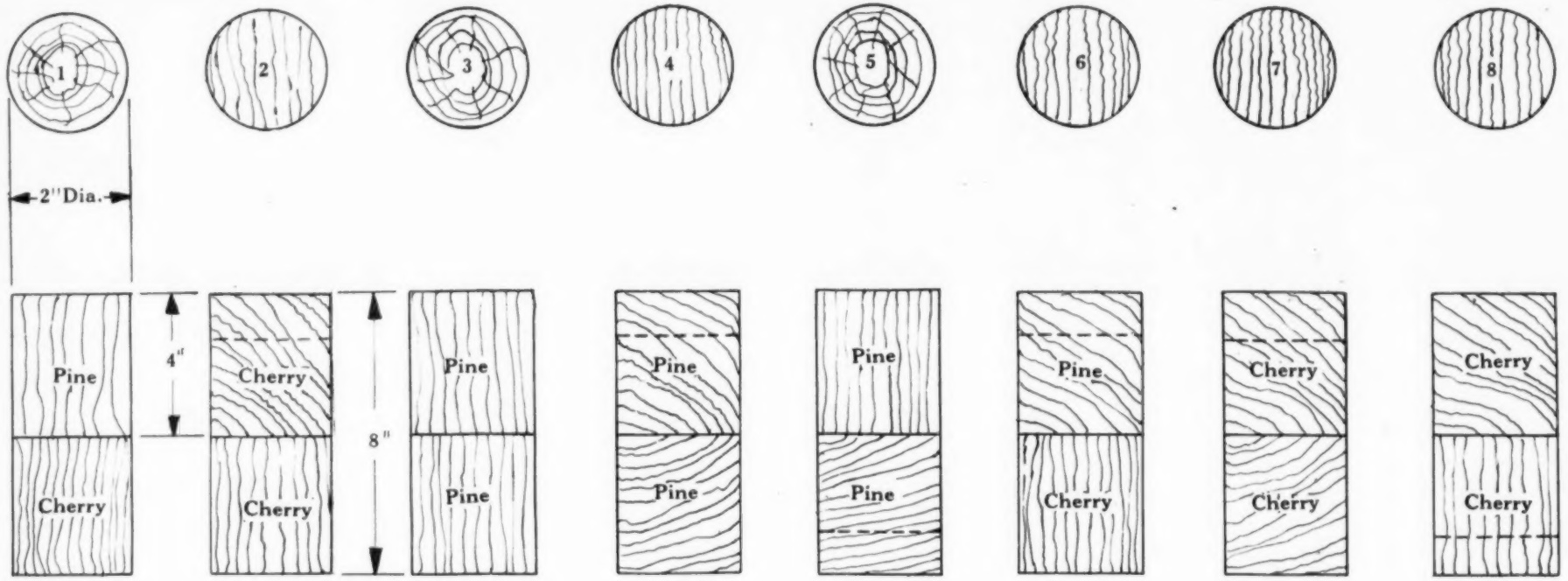
The wood broke in all cases where the grain of the wood ran parallel to the joint, showing that the glue was stronger than the wood. In each case the wood broke immediately under the jaws of the testing machine. It may be that the great variation between Nos. 2 and 8 was caused somewhat by the greater hold of the jaws on No. 8, as the jaws extended on it 2½ inches while on No. 2 the jaws held only 1 inch. However, it would seem that the wide difference in strength was due to some other cause, since No. 2 broke at 267 pounds per square inch and No. 8 at 933 pounds per square inch, a difference of 666 pounds.

No. 4, which was cross grain glued to cross grain, held better than No. 5, which was cross grain glued to end grain. Both of these test bars were pine, the difference in strength being only 3 pounds per square inch. No. 6, made of cross grained pine glued to end grain cherry showed a greater strength than No. 5. No. 4 broke 1½ inches from the end, No. 5 at 2 inches and No. 6 at 1½ inches from the end. No. 7, which was cross grained cherry glued to cross grained cherry, broke at 131 pounds per square inch. This piece was held 1 inch from the end, the same as No. 2, but held 136 pounds less.

Many Factors Considered

In looking over Fig. 1, it may be seen that contrary to popular opinion among patternmakers, in seven bars of the eight, the pieces that were glued end grain to end grain or end grain to cross grain held better than cross grain glued to cross grain, except in the case where No. 4 held better than No. 5.

However, there are many factors to be considered in constructing a pattern such as subjecting the pattern alternately to the dampness of the mold in the foundry and the dryness of the pattern storage. No doubt the joint made of cross grain glued to cross grain and in the same direction will last longer than



End grain glued to end grain	Cross grain glued to end grain	End grain glued to end grain	Cross grain glued to cross grain	End grain glued to cross grain	Cross grain glued to end grain	Cross grain glued to cross grain	Cross grain glued to end grain
Broke at glued joint at 1490 pounds 474 pounds per square inch	Broke at dotted line at 840 pounds 267 pounds per square inch	Broke at glued joint at 1330 pounds 423 pounds per square inch	Broke at dotted line at 600 pounds 191 pounds per square inch	Broke at dotted line at 590 pounds 188 pounds per square inch	Broke at dotted line at 720 pounds 229 pounds per square inch	Broke at dotted line at 410 pounds 131 pounds per square inch	Broke at dotted line at 2930 pounds 933 pounds per square inch

Average ultimate strength of glued joint 1410 pounds or 449 pounds per square inch.

Average ultimate strength of pine on cross grain 636 pounds or 203 pounds per square inch

Average ultimate strength of cherry on cross grain. The difference in these tests are too great to obtain a workable average.

Note—All joints rubbed, same glue used, drying 48 hours, and lumber kiln dried.

FIG. 1—RESULTS OF A TEST CONDUCTED TO DETERMINE THE BEST METHODS TO EMPLOY IN GLUING WOOD

in the other cases, since the action of the grain in swelling and contracting is in the same direction.

To make a good joint when applying glue, the parts of wood must have perfect contact. The surfaces of the wood must touch at all points and the glue must remain hot or in a liquid state until the pieces of wood are pressed together. Good glue usually is an amber color and is translucent. Glue pots are of various kinds and sizes, being heated with oil, electricity or steam. The steam pot consists of two vessels, an outer one to hold the water and steam, and the inner to hold the glue. The inner vessel is held in the hot water of the outer vessel. To prepare the glue, the inner vessel is filled about two-thirds full of flake glue, covered with cold water and allowed to stand an hour before putting into the outer vessel. After the glue has been heated and dissolved, either more glue or water may be added to the proper consistency. Prepared liquid glue also may be used. A small amount of vinegar is used to keep the liquid glue from molding. Glue brushes may be obtained in different sizes and they should be round and fairly stiff. The brushes used most are ¼, ½, ¾ and 1 inch in diameter, while frequently on large jobs a 2½ or 3-inch paint brush works fairly well. The patternmaker should not heat the same glue day after day or bring the glue to a boil, since this weakens the glue. The glue pot should be kept clean and the glue should not be allowed to get stale.

Securing a flat surface is easy today with surface grinders, but in days gone by this operation was rather difficult, since it was accomplished with a plane. A shop should have a surface table made of iron having a true surface and square edges. If possible, two tables should be used, one 2 x 4 feet and the other 4 x 6 feet. These tables may be used in many ways, such as for supporting the pieces while they are being glued, testing the pattern for squareness and for right angles, etc.

If the board has been planed true, it will have a tendency to stick to the table, requiring some effort to lift it. To find any uneven places on the board, a few marks should be made on the table with blue chalk and the piece of wood rubbed over the marks. The chalk will adhere to the high spots on the surface of the board. The high spots thus marked should be planed off until the wood is true and the chalk shows all over the surface of the board.

The wood to be glued should be cleaned with a cloth or brush and all dust, chalk or sand removed so that the glue may enter the pores. After the glue is applied to the wood, the sur-

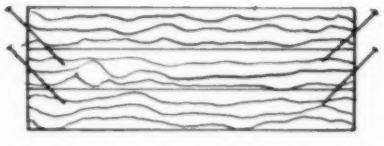


Fig. 2

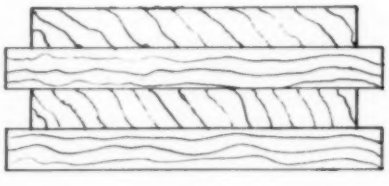


Fig. 3

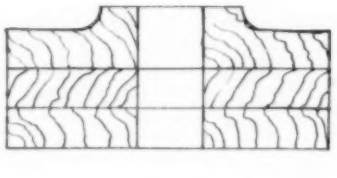


Fig. 4

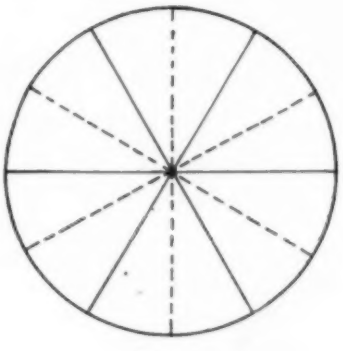


Fig. 5

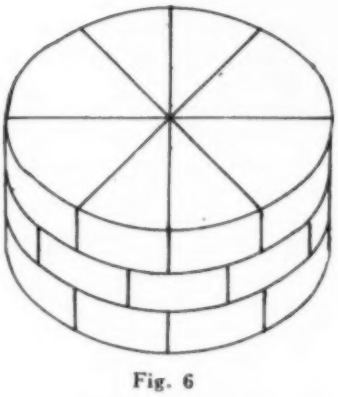


Fig. 6

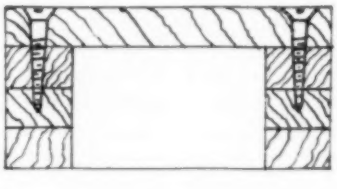


Fig. 7

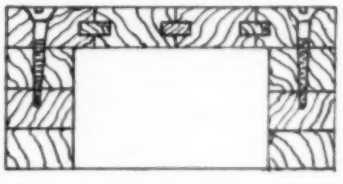


Fig. 8

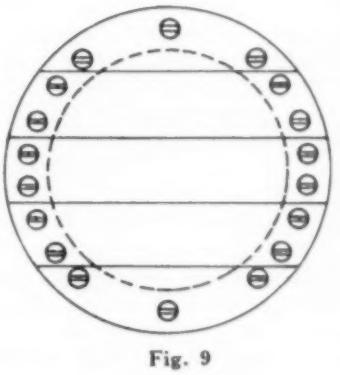


Fig. 9

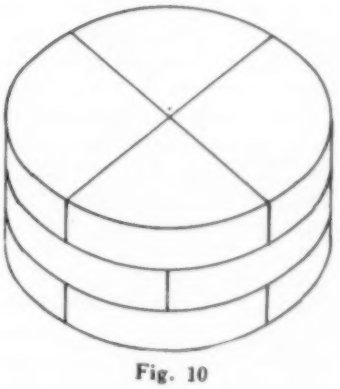


Fig. 10

FIG. 2—NAILS ARE USED TO HOLD THE PIECE WHILE CLAMPING FIG. 3—AN INCORRECT METHOD OF GLUING FIGS. 4-5—THE FLANGES SHOULD BE BUILT OF THREE OR MORE LAYERS OF SEGMENTS FIG. 6—THE ANNUAL RINGS SHOULD PREVENT THE PIECE FROM COMING APART FIG. 7—BACK MADE WITH A SINGLE BOARD FIG. 8—BACK MADE OF SPLINES FIG. 9—THE PIECES ARE SCREWED ON WITH THE SPLINES FIG. 10—THE BACK IS BUILT OF SEGMENTS REACHING THE CENTER

faces should be rubbed together until all of the surplus glue is rubbed out of the joint. A rubbed joint without clamps is best, since clamps often cause a strain which may cause the wood to come apart in time. Frequently the clamps bend the wood out of shape. However, the use of clamps is common since it is speedy and is a fairly sure method. To hold the work being glued in the correct position while being clamped, brads may be toe-nailed in the end of the wood to keep the work from sliding when the clamps are tightened. An example of this method is shown in Fig. 2. After the glue has set and the clamps are taken off, the brads may be extracted.

It is not good practice to glue lumber with the grain of the wood at right angles. It is better in this case to fasten the pieces together with screws, since the shrinkage and swelling of the wood across the grain of each layer of wood will cause the glue to give away. The incorrect method of gluing the wood with the grain at right angles is shown in Fig. 3. It is better to have at least three layers of wood glued together, as two layers will warp considerably more than a greater number, either with straight or segment work.

In circular work, such as in the flange, Figs. 4 and 5, the shape should be built of three or more layers of segments. The joints should not be put one above the other and the annual rings should be so placed as to check each piece from coming apart. This method is shown in Fig. 6. When a pattern is to be made, as in Figs. 7, 8 and 9, and a cheap back is wanted, the back is made in the way shown. Fig. 7 shows a single board screwed onto the segments. This is a fairly good method for use in small patterns, but in time the wood may crack, since the segments will stay fairly round and the single board will swell and shrink. The joint between the board and the segments will show an unevenness as is illustrated in Fig. 3, which will necessitate undue rapping when the pattern is being drawn from the sand.

In larger work the back may be made up of narrow tongue and groove boards, or made with separate pieces called splines, as shown in Fig. 8. The pieces may be screwed on with the splines, Fig. 9. The objection that the joint is rough applies to the method shown in Figs. 8 and 9. A better way is to build the back of segments which will reach to the center, Fig. 10. In making a mold of this kind it is not necessary to have a back on the pattern, as the mold may be swept.

The Chemical Treatment Co. has established headquarters in larger offices at 81 New street, New York.

Publishes New Handbook

The Metal Industry, 34 Bedford St., London, England has issued a new edition of its handbook and directory following the general arrangement previously adhered to but with important additions. A new section dealing with cast iron and steel data has been added to correspond with the new sphere of activity entered upon by the iron foundry section of the publication. New tables for iron and steel wire data have been added with new tables showing the metric weights of copper, and brass wires and sheets corresponding to imperial wire gage sizes, also English weights of metric sizes of copper bolts.

The most important features have been retained, and some compositions of aluminum and zinc alloys have been added. Important new tables of the physical constants of several of the more important brasses and bronzes have been incorporated, also tables showing the effects of elevated temperatures and different annealing temperatures.

New lists giving time required for electrically depositing definite thicknesses of cobalt and nickel have been included and data regarding the method of determining the workability of metal sheets and wires introduced in the section dealing with testing machines.

Organize Sales Firm

The Hopp-Patterson Co. recently has been organized with offices at 902 Hearst building, Chicago, to act as district representative for various lines of industrial equipment and supplies. The organizers of this company are J. H. Hopp, for 15 years associated with Charles C. Kawin Co., Chicago, consulting metallurgists, foundry and industrial engineers, in the capacity of vice president and engineer, and J. B. Patterson, for 7 years associated with the P. H. & F. M. Roots Co., Connersville, Ind., manufacturers of pressure blowers, gas and rotary pumps, as district sales manager at Chicago.

Book Review

Arc Welding Handbook; by C. J. Holslag; 243 pages, 5 x 7½ inches, published by the McGraw-Hill Book Co., Inc., New York and furnished by THE FOUNDRY, Cleveland for $2.00, net.

This book is intended to serve as a simple and practical manual of instruction in arc welding. An attempt has been made throughout the volume to describe the methods, in a clear and practical manner so that the beginner may understand both the equipment and the processes and how to recognize and set up various types of welding apparatus. To the engineer, draftsman, and designer this volume should serve as a guide in arc welding. The author has kept in mind not only the needs of the beginner, but those of the men who supervise such work. This volume should prove useful to teachers in technical, trade and other schools where instruction in arc welding is offered. To this end questions have been added at the conclusion of each chapter. Features of special interest to foundrymen will be found in the chapters dealing with welding cast iron and malleable iron, welding thin sections of cast iron, welding nonferrous metals and the use of the carbon arc. This volume carries a large number of illustrations and is fully indexed.

Materials Employed for Washing Molds

Question: We are interested in ascertaining in a general way the extent to which mold washes are used in the foundry industry. We have particular reference to sodium silicate where used either pure or combined with such materials as graphite, silica, etc. What is the specific object of employing a wash? Is it to produce a hard firm skin on the sand to prevent the metal from washing it away, or is it designed to affect the surface of the casting in a case hardening way or otherwise.

Answer: Molds are washed for the double purpose of producing a hard skin on the surface of the sand and supplying a refractory coating that will prevent the sand from fusing to the molten metal. The only molds that are washed are those which later are dried in the oven or skin dried with a torch or some convenient form of portable fire. Three materials are employed almost universally for mold washes. Graphite and talc are used on molds for iron and heavy brass castings. Silica is painted on molds for steel castings. The material is mixed with water to the consistency of cream and a small quantity of some binding agent is added to the water so that the material will adhere to the face of the mold after the water has been dried out. The most commonly used binding agent is molasses, but other forms of binder, particularly waste liquor from pulp and paper mills is used extensively. Sodium silicate (water glass) is not used to any extent in the foundry industry. Its principal application is in the form of a protective coating for steel or iron inserts.

The Worthington Pump & Machinery Corp., New York, has placed a contract with the Austin Co., Cleveland, for the construction of a new unit to its Buffalo plant. The building will be 80 x 200 feet and two stories high.

Veteran Had Rare Foundry Career

ROBERT E. MASTERS whose occasional contributions of a reminiscent character in several recent issues of THE FOUNDRY have served to re-establish his contact with the industry, was well known to a former generation of foundrymen through a prolific pen. He was a pioneer along many lines, original, resourceful, a master foundryman and also one of the first to describe and discuss foundry subjects in the columns of the technical press. He enjoyed a wider and more comprehensive experience than falls to the lot of the average man, before he retired several years ago to a home in La Mesa, Cal. Now at the age 76, from his calm and peaceful retreat he looks back over the long, long road and sees himself as boy and man spurred on by necessity and ambition, standing on his own two feet, grappling with his own problems as they arose from day to day, in many cases without any precedent for a guide. He finally retired from active participation in the industry which he served so long and so faithfully and with such a marked measure of success both for himself and for those who were fortunate enough to come into contact with him either personally or through his contributions to foundry literature. He retired at a time while still in condition mentally and physically to enjoy life in a manner that appeals to his taste and inclination.

He still retains the facility with the pen which gained him such a measure of prominence in the eighties and nineties. In addition to writing the reminiscent articles appearing from time to time in THE FOUNDRY he is a regular contributor to the local papers in his vicinity and presents entertaining descriptions of personal experiences with insects, birds, animals, reptiles and fish. These intimate glimpses not only refer to recent observation, but extend over a period of many years and embrace incidents connected with fishing and hunting expeditions in all parts of the United States, in the Great Lakes, the gulf of St. Lawrence, the Atlantic sea board, Florida, the gulf of Mexico and the Pacific ocean.

Came From Eastern Stock

Mr. Masters was born on Christmas day 1848 in the city of New York where his immediate ancesters had resided since 1700. At the age of 10 he found himself under the charge of a guardian, the manager of a traveling circus which spent six months of each year on the road and the remaining six months on the famous Bowery of these days. The future foundryman spent 8 years with this aggregation and at an age when the average boy is thinking timidly of stepping into the swirling stream of industrial life, the young thespian was an accomplished man-about-town and what is known in the present generation as a good mixer.

This early experience stood him in good stead in after years and was responsible in large measure for the success which crowned his efforts as manager of several large foundry interests. Through his personality he gained the friendship of influential men who controlled vast industrial enterprises, for example E. H. Harriman and Jay Gould, and retained the friendly contact throughout the life time period of those noted characters.

Even in his trouping days the young man's mind had a natural inclination toward applied mechanics and this influenced his guardian to indenture him at the age of 18 for a 3-year apprenticeship with a prominent foundry in New York. During the period of his apprenticeship he applied himself diligently to an intensive study of the principles underlying the art of iron founding. The same restless energy, the consuming curiosity, the insatiable passion for investigation, the desire to know the how and the why of various phases of foundry practice which characterized his entire active subsequent career in the foundry, were developed during the period of his apprenticeship.

After graduating at the age of 21 as an all around foundryman Mr. Masters spent about 10 years in responsible positions in foundries in the East and the Middle West and then accepted a position as foundry manager with the Tredegar Iron Works, Richmond, Va. His subsequent foundry career was all spent in the South and South West either in a consulting capacity or as manager of various foundry interests. Prior to his actual retirement from the foundry field he served for several years as general manager of the Marshall Foundry, Houston, Tex.

One of the most interesting incidents in an exceedingly busy and colorful life, an incident that illustrates to a certain extent his standing in the estimation of the foundrymen of his day, occurred at the time of the Paris exposition 1889. A syndicate of American newspapers decided to send a group of industrial writers to Europe to gather and afterward present first hand impressions of conditions as they prevailed among the working classes of these countries. The idea has been duplicated in whole or in part several times since, but on this first occasion it was sufficiently novel to attract considerable attention. From a long list of prominent men considered eligible through their familiarity with the subject and their facility in presenting their views to others, Mr. Masters was selected to cover the ground from a foundry standpoint.

Adopting Form Would Cause Saving

A survey has been conducted by W. L. Chandler, secretary of the National Association of Purchasing Agents, Woolworth building, New York, to determine the saving that would be possible through universal adoption of the national standard invoice form. The survey covered 35 business corporations of average size. Each of the corporations was asked to estimate what might be saved in purchasing and accounting departments provided all invoices received were on the standard form. The estimated economies vary, but the total estimated savings amounted to $21,700 making an average of $620 annual saving for each of the firms. If the 25,000 companies of corresponding size scattered throughout the United States, Canada and Mexico were to receive corresponding benefits, the annual saving would total millions.

This national standard invoice form was prepared by the National Association of Purchasing Agents, division of purchases and stores of the American Railway association, American Railway Accounting Officers association and National Association of Cost Accountants. In arriving at the national standard invoice form three national conferences were called by the National Association of Purchasing Agents. The first one in Philadelphia in 1919 was held to study an exhibit which had been prepared by the standardization committee of the National Association of Purchasing Agents, of which Mr. Chandler was then chairman. As a result of a conference of representatives of a number of national trade and professional associations, a tentative form was adopted for criticism. One year later another national conference was called at Chicago to consider the criticisms and suggestions which had been received by the committee during the year. Another tentative form was adopted and the following year another national conference was held at Philadelphia to consider the changes proposed for the second tentative form. At this conference the present form was adopted and has since been fully endorsed by the four bodies whose committees cooperated in its preparation. The form is shown in the accompanying illustration.

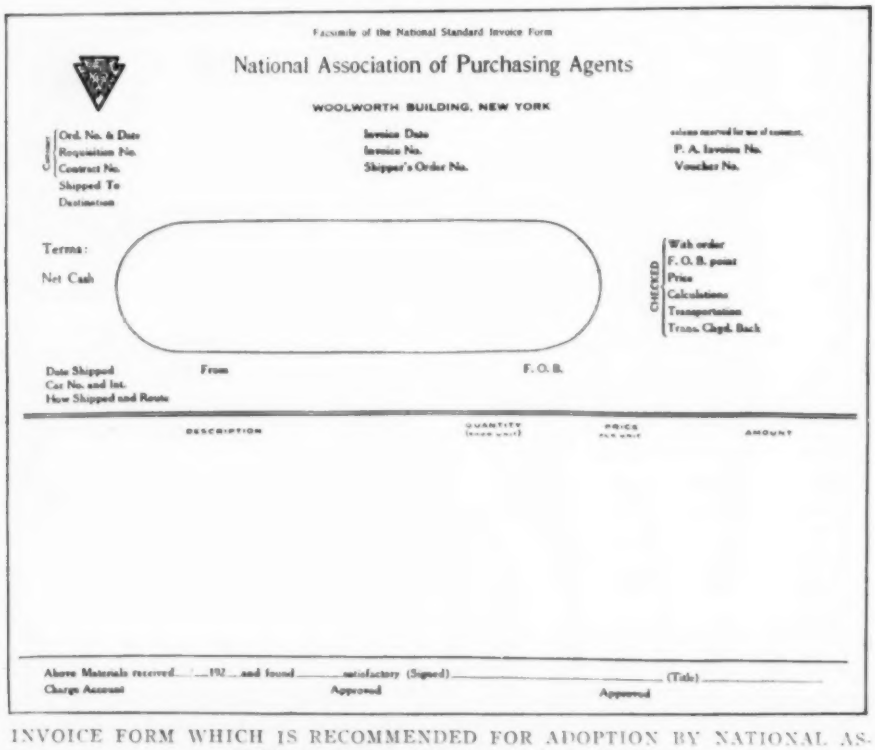
The National Association of Purchasing Agents and the other bodies which have endorsed this invoice form are making a particular effort to secure the more general adoption of the form which must be accomplished before the benefits may be derived. This organization reported an increasing interest in the form.

Molds Large Iron Gear Case

(*Concluded from Page 627*)

About 25 tons of miscellaneous weights were placed on top of the binders to supplement the bolts in holding the core and cope in place during pouring.

Assembled cores suspended from the cope are shown in Fig. 8. One of the core units is shown on the core oven car in Fig. 5 and the general character of the coreboxes is shown in Figs. 6 and 10. Heavy, cast-iron arbors were placed in the cores and were provided with suitable loops and bolt holes to facilitate handling the core either horizontally or vertically. One of these arbors is shown to the right in Fig. 10. The same illustration shows the manner in which the corebox and plate were bolted together before they were rolled over and placed on the core-oven car where the corebox was removed. The combined weight of the corebox, sand and arbors is approximately 5 tons. The cores were made from a coarse grade of bank sand, half old and half new, bonded with a dry binder. In addition to the arbors they were reinforced with rods and to facilitate drying the interior was filled with coke. The flange covering cores were made from sharp sand bonded with oil.


Facsimile of the National Standard Invoice Form

National Association of Purchasing Agents

WOOLWORTH BUILDING, NEW YORK

Ord. No. & Date
Requisition No.
Contract No.
Shipped To
Destination

Invoice Date
Invoice No.
Shipper's Order No.

P. A. Invoice No.
Voucher No.

Terms:
Net Cash

CHECKED
With order
F. O. B. point
Price
Calculations
Transportation
Trans. Chgd. Back

Date Shipped
Car No. and Int.
How Shipped and Route

From

F. O. B.

DESCRIPTION | QUANTITY | PRICE | AMOUNT

Above Materials received ____ 192 ____ and found ____ satisfactory (Signed) ____ (Title) ____

Charge Account | Approved | Approved

INVOICE FORM WHICH IS RECOMMENDED FOR ADOPTION BY NATIONAL ASSOCIATION OF PURCHASING AGENTS

Refining Metals Electrically

(*Concluded from Page 642*)

oversize charges. This gave a flat hearth like that shown in Fig. 15. Data collected and analyzed gave us the following:

The time of melting, power, electrode consumption, etc., were similar on both hearths.

Labor required to poke in scrap was less on No. 1, Fig. 14, the steep banks causing the scrap to fall in of its own initiative.

Roofs did not give quite as long a life with hearth No. 2, Fig. 15, due probably to the fact that the distance from bath to roof was less than on No. 1.

Time of charging was greater on No. 2, Fig. 15.

Refining and superheating was superior and quicker on No. 1 on account of a smaller area of bath exposed with its attendant greater radiation loss. This also required a smaller volume of slag to act as a heat conserving blanket, giving a slight favor in power consumption.

From these data, the fact was accepted that on acid operations a deep, bowl-shaped hearth is superior to the flat hearth. Later operation figures have proved this point, and in addition have shown a more favorable power consumption. Such a hearth is easy to keep in condition, and offers a minimum of trouble caused by electrodes digging or arcing against the walls.

The foundry of the Gillespie Eden Corp., Paterson, N. J., has been purchased by a group of foundrymen who will place it in early operation. The purchase price is said to be around $350,000. The foundry was erected shortly after the world war and for the past year has been idle.

Small Cupola Melts Iron at Rapid Rate

Question: I am enclosing a sketch of a cupola at one time lined to 30 but now lined down to 24 inches. The sketch also shows the relative sizes and position of the motor, blower, blast pipe, windbox and tuyeres. I am only running small heats, between 4000 and 5000 pounds and the material is charged in the proportion of 500 pounds of iron to 60 pounds coke. The iron appears to lack life. Also, it melts at the rate of 4000 pounds per hour which is faster than we can handle it on small work. Usually we tap into a 750-pound ladle and pour the greater part of our castings from this ladle. Iron caught in a hand ladle under the spout is satisfactory, but where we have to transer the metal from one ladle to another, it is too cold to run the castings. The first two charges are made up of 90 per cent scrap and 10 per cent No. 2 foundry pig iron to which is added 2 per cent of a mixture of ground ferromanganese and ferrosilicon, 4 parts of ferrosilicon to 1 part ferromanganese. On account of the speed with which the iron melts the blast has to be shut off for several minutes during the progress of the heat. The tuyeres are poked and the first iron after the shut down is poured in the pig bed. The following iron is fairly hot at the spout but cools quickly. I will appreciate your advice on how to operate this cupola properly.

Answer: Instead of commenting on the various features of your present practice it will be more to the point to indicate what your practice should be to obtain satisfactory results.

After the cupola has been chipped and daubed the bottom doors are propped in position and fairly dry sand is rammed over them to a depth of 4 inches. If this sand is wet or if it is rammed too hard it will cause the first iron to boil. The steam from the sand cools the iron and hardens it. The breast is made up inside and outside, after which a sufficient quantity of shavings, waste or paper is placed on the sand to ignite the wood placed above. The wood is followed by the coke. The amount will vary to some extent from time to time, depending on whether the cupola is newly lined, or burned back a few inches at the melting zone. The only important point is that the coke shall be at least 24 inches above the tuyeres when it has burned through and settled down. A layer of coke about 6 inches thick then is added and the first charge of iron is placed. Your present ratio of coke to iron on the charges should deliver satisfactory iron, but if it is still comes cold, add another shovelfull of coke to each charge.

Your trouble primarily is due to the fact that your coke is cut to the absolute minimum. It is sufficient to melt the iron, but it is not sufficient to raise it to a temperature suitable for your conditions. Your blower was designed to serve a larger cupola and while you get fairly satisfactory results by keeping the gate in the blast pipe partly closed, still you are wasting power and wrecking the belt, driving the fan at such a high speed. We suggest you open the wind gate to the full size of the pipe and reduce the speed of the fan by at least one third. These changes will reduce the melting speed of the cupola and produce hot iron.

Elect New Officers

Acquisition of additional plants by the Link-Belt Co., Chicago, and the extension of the business of the company during the past 5 years, has resulted in several changes in the executive department of the company. At the board meeting on July 24, the chairman of the board of directors was made the chief executive officer and an executive committee of four was created to act as an advisory board to the officers. Charles Piez, formerly president, was elected chairman of the board of directors and of the executive committee. Alfred Kauffman, second vice president, was chosen president and Staunton B. Peck was elected senior vice president. The direction and supervision of sales was delegated to Mr. Kauffman. Arthur C. Johnson, elected second vice president, remains in charge of operations and sales in the western district, Mr. Peck being in similar charge in the eastern territory. Humphrey J. Kiely, newly elected third vice president, continues in charge of exports and sales in the New York district.

Plan Annual Meeting

The fourth annual convention of the Ohio State Foundrymen's association will be held at the Cleveland hotel, Cleveland, Thursday and Friday, Sept. 18 and 19. An exceptionally interesting program dealing with foundry problems is being prepared. Among the prominent speakers engaged is Walter Gordon Merritt, League for Industial Rights, New York city, who will address members of the association and visitors at the meeting Friday afternoon. Friday morning will be occupied by an inspection trip to Nela Park as guests of the national lamp division, General Electric Co. A golf tournament is being arranged.

Note Coating Formed on Corroded Metals

Results of a series of tests on the coating formed on corroded metals and alloys is the subject of a paper prepared by George M. Enos, instructor of metallurgy, University of Cincinnati, and Robert J. Anderson, metallurgical engineer, Boston, Mass. and presented at the meeting of the American Society for testing materials held at Atnlantic City, June 24-27 1924. The tests showed that an important factor affecting the rate and nature of corrosion of metals and alloys is the film, or coating formed on the surface. This may accelerate or retard corrosive action once started. The formation of films and coatings is intimately associated with the chemical composition and physical constitution. of both the metal and the corroding medium. A film or coating may be either the corrosion product resulting from oxidation, a deposition of suspended matter from the corroding media upon the surface of the metal or, a mixture of both. Such a coating may adhere tightly or loosely to the surface of the corroded metal.

To study the effect of the surface conditions of alloys on coating formations, corrosion tests were made on a selected group of nonferrous alloys in acid mine water. Duplicate tests samples of various compositions, with one set of a given composition in the as-cast or as-rolled condition and the second set of corresponding composition machained or polished were immensed in flowing acid mine water for 73 days. Eight nonferrous alloys were selected for test which included materials known by previous experience to have formed thick coating. One rolled sample of monel metal was included in the tests. The seven other samples were cast metal and included leaded cupro-nickel, chromium iron-cupro-nickel, lead-zinc bronze, aluminum bronze, and leaded bronze.

The coatings formed on the samples were not disturbed during the exposure period. After exposure a microscopic examination was made of the samples to observe the coatings formed. The structure of the coating is important as a flocculent or honeycomb structure will not retard corrosion as well as a compact structure. The tests showed the acid resisting properties of the different samples, and that the rates of corrosion on the as-cast and machined samples were practically the same.

C. H. McConnell has been made manager of the Globe Steel Abrasive Co., Mansfield, O.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND, O.

BRANCH OFFICES

BOSTON.....426 Old South Bldg.
CHICAGO.....1147 People's Gas Bldg.
CINCINNATI.....406 Edwards Bldg.
NEW YORK.....2203-2206 No. 220 Broadway
PITTSBURGH.....2148-49 Oliver Bldg.
SAN FRANCISCO.....675 Monadnock Bldg.
WASHINGTON, D. C.....84 Home Life Bldg.

FOREIGN OFFICES

BIRMINGHAM, ENGLAND.....Prince's Chambers
LONDON, ENGLAND, 2-3 Caxton House, Westminster, S.W.1
PARIS, FRANCE.....23 Rue de la Bienfaisance VIIIe
Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....£1:0:0 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulations, Associated Business Papers, Inc., and National Publishers Association

Entered at the Post Office at Cleveland as Second Class Matter

Copyright 1924 by The Penton Publishing Co.

Contents

	Page
Molds Large Iron Gear Case	623
Study Structure of Gray Iron	628
Innagurate New Plant for Auto Malleables	634
Firebrick to Resist High Temperatures	634
Form Sales Corporation	634
Standardizing Test Methods	635
Apparatus Determines Permeability	635
Brass Washers Split	639
Lectures on X-Ray	639
Refining Metals Electrically	640
Bill on How and Why Molds Are Stacked—IV	643
Elect New Officers	645
How and Why in Brass Founding	646
Pinholes in Castings	646
Die Casting Methods	646
Making Yacht Fittings	646
Pure Copper Castings	646
Glue Used in Patternmaking	647
Publishes New Handbook	650
Organize Sales Firm	650
Book Review	650
Methods Employed in Washing Molds	650
Veteran Had Rare Foundry Career	651
Adopting Form Would Cause Saving	652
Small Cupola Melts Iron at Rapid Rate	653
Elect Officers	653
Plan Annual Meeting	653
Note Coating Formed on Corroded Metals	653
Isolation Causes Stagnation	654
Trade Outlook In the Foundry Industry	655
Personal	656
Building Factory	656
Occuppy Own Laboratory	656
Carolina Members Meet	656
Has Charge of Sales	656
Interest Shown in Club	656
Appointed Sales Manager	656
Joines Sales Force	656
Purchases Foundry	656
Opens Cleveland Office	656
Designs Cooling Fan	657
Makes Grease Cup	657
Brazes Saw Bands	657
Valve for High Presures	657
Offices Are Moved	657
Building New Plant	657
Obituary	657
Belt Sander May Be Used in Two Positions	658
Arc Welding Equipment Is Portable	658
Pneumatic Hoist Handles Foundry Materials	658
Market Tone Is Better	659
What the Foundries Are Doing	660

Isolation Causes Stagnation

NO MAN is sufficiently versed in any line of endeavor that he can afford to become satisfied with himself or his business condition. To become self-centered is the first sign of stagnation. Such a condition places any one at a disadvantage in carrying forward successfully any commercial enterprise.

The arts and manufactures during the past decade have advanced with such rapid strides that it is impossible for the individual to cover in a detailed manner the vast fields of any particular line of thought and successfully apply to individual uses the advantages which such knowledge affords.

Therefore, men meet and discuss their problems. They bring together their common interests for the mutual good. They have come to realize that in aiding others they are benefitting themselves. By imparting knowledge they gain knowledge. The mists of secrecy have been dispelled by the light of knowledge and understanding.

Men of broad vision realized the limitations of individual effort and the great advantages to be derived from united effort. They promulgated the technical societies for the advancement of knowledge in the endeavor to keep abreast of the times. As a further incentive to advancement along the lines of applied science, the outstanding technical societies from time to time have sponsered symposiums where interesting papers are read and animated discussions brought forth. Such symposiums are meeting places of advanced thought and a means of bringing forth and developing the best methods of procedure to advance any line of endeavor.

Foundrymen have derived great benefits by attending such meetings. They have been broadened by their association with others in a like calling with similar problems to solve. They have been brought to understand the full significance of the term *friendly* competition. They have had opportunity to get the other fellows point of view and a knowledge of his ways of doing things. All of these have had a broadening influence. Progress has been made through association and co-operation.

Robert Fulton designed and operated the first successful steamboat on the Hudson River over a century ago, and during the succeeding years his original idea has been developed until steamships ply the seven seas. However, it required the co-operation of the keenest engineering minds in metallurgical, mechanical and electrical fields to produce the mighty driving power of the modern liner. This is no one man's idea, but is the summation of the best modern practice and experience. Great achievements are being made in all lines of endeavor and are not the outcome of one man's efforts, but result from the co-operation of many. It is the general belief that symposiums will be a means toward further developments along the various lines of endeavor and will in the end greatly benefit manufacturers.

Symposiums such as those on sand research offered during the past few years by the American Foundrymen's association, or the round table discussions on electric furnace practice organized by the American Electrochemical society result in untold benefits. They quicken interest, stimulate research and above all make available to the practical man, the thoughts and experiences of his fellows in the paths of theoretical and applied knowledge.

Trade Outlook in the Foundry Industry

WHETHER induced by the trying experience of 1921, or governed by the increase in available information covering stocks of materials and rate of production, manufacturers are not accumulating heavy inventories of materials. Nor is the foundry industry an exception. Foundrymen are buying iron, coke and other necessities only as they are needed for immediate use. An instance is cited of a large foundry in northern Ohio which has had 200 tons of coke per month under contract. It has deferred delivery on this order for four consecutive months, despite the fact that it has been consuming its available supply and has only a limited amount at hand.

Coke Output Hits Depths

The July production of Connellsville coke aggregated only 209,410 tons, a decrease of 84,920 compared with the June figure. The past month showed the lowest production since September, 1921, and the present price closely approximates that obtaining during the 1921 depression. Pig iron production again declined in July, according to statistics compiled by *Iron Trade Review*. The drop was less than that noted for June, but the total of 1,783,778 tons is below the two million ton figure for the first time since August, 1922. The production of July is 51.5 per cent of the high marked reached last March. On a daily average basis, the production for last month was at the rate of 57,541 tons per day, a loss of 9886 tons compared with the June rate. This represents a decline of 14.6 per cent, while the loss of June's output compared with the May total was over 20 per cent. The total production of merchant iron was 459,841 tons for July, against 551,408 tons in June, giving a loss of 91,567 tons. The July daily average rate was 14,833 tons, a drop of 3547 tons compared with June's rate, or a loss of 19.5 per cent. During the past month one furnace was started and nine blown out or banked.

Prices for Raw Materials for Foundry Use

CORRECTED TO AUGUST 7

Iron		Scrap	
No. 2 foundry, Valley	$19.00 to 19.50	Heavy melting steel, Valley	$18.00 to 18.50
No. 2 southern, Birmingham	18.00 to 18.50	Heavy melting steel, Pitts.	18.00
No. 2 foundry, Chicago	20.00	Heavy melting steel, Chicago	15.00 to 15.50
No. 2 foundry, Philadelphia	20.76 to 21.76	Stove plate, Chicago	16.00 to 16.50
No. 2 foundry, Buffalo	19.00	No. 1 cast, Chicago	18.75 to 19.25
Basic, Valley	19.00	No. 1 cast, Philadelphia	17.00 to 18.00
Basic, Buffalo	19.00	No. 1 cast, Birmingham	15.00 to 16.00
Malleable, Chicago	20.00	No. 1 cast, Buffalo	16.00 to 16.50
Malleable, Buffalo	19.00	Car wheels, iron, Pittsburgh	17.00 to 17.50
Coke		Car wheels, iron, Chicago	16.50 to 17.00
Connellsville foundry, coke	$4.00 to 4.50	Railroad malleable, Chicago	17.50 to 18.00
Wise County foundry, coke	4.50 to 5.00	Agricultural mal., Chicago	16.50 to 17.00
		Malleable, Buffalo	17.50 to 18.00

Operations Are Slack

In practically all lines, foundry operations are at a low ebb. Jobbing foundries have only occasional orders, some of the larger specialty shops being glad to maintain an incomplete force, employed only three or four days a week. Malleable shops, except the railway equipment plants, are operating at less than 30 per cent of capacity. According to the department of commerce, the June production of 132 plants was only 33,876 tons, against orders booked of 28,880 tons and with a total capacity listed of 108,520 tons per month. The rate at which the shops were operated is given as 31.2 per cent of capacity. A comparison of 109 identical malleable foundries gives 32.1 per cent as the rate of operations for June, compared with 46.0 per cent for May and a peak of 66.2 per cent attained in March. Steel jobbing shops with a few exceptions are only slightly more fortunate. Those foundries which operate as departments of large establishments are keeping fairly busy on stock work. This is noted among gray iron departments of road machinery, contractors equipment and a few machine tool plants.

Auto Outlook Brightens

Although many of the large automotive foundries still are operating on greatly reduced schedules, a few notable exceptions are found. Some of the manufacturers of passenger type automobiles with self contained foundry departments, again have started production of castings, even specifying in excess of immediate requirements in anticipation of improved automobile sales in the early fall. Output of all classes of automobiles for June showed a further decline, according to the department of commerce. The total output is given as 245,790 against 312,858 for May and with March attaining the high total output of 382,474 cars. In the past three months, production has been cut 35 per cent, but the opinion prevails that the bottom has been reached and a rebound may be expected. An increase in prices is noted in marked contrast to the decrease in steel and other materials employed in automobile construction. Employment figures in the Detroit district indicate an approaching revival in activity. The situation noted in the case of automobile production governs in many lines. According to the National Association of Purchasing Agents, the amount of coal consumed for industrial purposes declined only 2¾ per cent in June, compared with drops of much higher percentages in preceding months. June consumption declined 23½ per cent below the same month last year. Building construction is slackening slightly, particularly in the western states. Car loadings, taken as a measure of industrial activity, are improving. For the seven day period ending July 19, a total of 930,284 cars was reported by the American Railway association, compared with 910,415 cars in the preceding week. Grain is starting to move and general merchandise and small shipment loadings are increasing. Railways again are entering the market for cars and miscellaneous requirements. The total of locomotive shipments for July was 140 compared with 145 for the preceding month.

Nonferrous Prices

New York prices on nonferrous metals, according to the *Daily Metal Trade* of Aug. 6, follow: Casting copper, 13.00c; electrolytic copper, 13.25c; Straits tin, 51.50c; lead, 7.60c; antimony, 8.87½c; nickel, 30.00c; aluminum No. 12 alloy, remelt, 21.00c. Zinc is 6.47½ to 6.50c, E. St. Louis, Ill. Average monthly prices for July follow:

New York Prices

Castings Copper	Electrolytic Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
12.405	12.648	7.187	46.201	8.448	26.50	5.897

Personal

Verne E. Minich, president of the American Foundry Equipment Co., New York, has sailed for Europe.

A. F. Corner, one of the incorporators of a brass and aluminum foundry at 815 Spring street, Coffeyville, Kans., formerly was superintendent of the pattern department of the Acme Foundry & Machine Co., that city.

H. G. Skitch has been appointed manager of the pump department of John T. Hepburn, Ltd., Toronto, Can. Douglas Cameron has been appointed manager of the machine shop and foundry department.

D. W. Jordan, formerly foundry superintendent for Reed & Prince Mfg. Co., Worcester, Mass., and later associated with the Mansfield Foundry Co., Mansfield, Mass., has now been appointed foundry superintendent of the Athol Machine Co., Athol, Mass.

Dr. Udo Lohse, superintendent of technical schools, Hamburg, Germany, has completed a six weeks tour of the United States in the interests of his foundry training supervision work. Dr. Lohse formerly was in charge of a foundry in Chemnitz, Saxony, but for many years has been engaged in teaching and in consulting practice.

H. J. Criss has established the Criss Sales & Engineering Co., Erie, Pa. which will conduct a general commercial and foundry engineering business in addition to making castings. Mr. Criss for many years was foundry superintendent for the Coe Mfg. Co., Painesville, Ohio, and more recently was plant superintendent for the Southern Engine & Boiler Co., Jackson, Tenn. His foundry experience covers employment with the Farrel-Cheek Steel Foundry Co., Sandusky, Ohio and the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

H. A. Schnitzer has been made foundry superintendent at the Lancaster plant of the Burnham Boiler Corp., which also operates plants at Irvington and Elizabeth, N. J. Mr. Schnitzer first became connected with the foundry industry when he operated a jobbing foundry in Orrville, O. In 1912 he accepted a position with the Williamson Heater Co., Cincinnati ,serving as assistant superintendent until 1917 when he was made superintendent of the Oakley plant of that company. In 1920 he accepted a position with the Fox Furnace Co., Elyria, O., where he designed equipment for a new line of furnaces. This plant later was purchased by the American Radiator Co. He resigned his position in April 1924, effective June 15, completing four years' service.

Building New Factory

The Buckeye Products Co., Cincinnati, is constructing a new factory and warehouse at Carthage, a suburb of that city The factory will be equipped to manufacture foundry parting, core oils, core compounds, refractory cements, nonferrous metal melting furnaces and other specialties and supplies. D. Meinken & Son, Cincinnati, are contractors.

Occupy Own Laboratory

The British Cast Iron Research association recently took possession of its own laboratory located on Guidford street, Birmingham, England. The new laboratory is equipped to conduct chemical analyses and general heat treatment and metallurgical work. The capacity of the association is increased greatly, but it does not intend to abandon the policy of having investigations conducted in the laboratories of prominent universities and in the works of members.

Carolina Members Meet

The Carolina members of the Southern Metal Trades association met in Asheville, N. C., recently. E. L. Nash Carolina Foundry & Machine Co., Winston Salem, N. C. discussed the proper melting of iron. George S. Dewey, Dewey Bros., Inc., Goldsboro, N. C., talked on the effect of different chemical elements in castings. W. T. Harding, Raleigh Iron Works, Raleigh, N. C., discusser how best to deal with employes in a manner most profitable to employer and employe. W. N. Mitchell, Baltimore & Ohio railroad, Atlanta, Ga., discussed freight rates and charges.

Has Charge of Sales

H. L. Woolfenden has been placed in charge of sales of the Scott Valve Mfg. Co., Detroit. Mr. Woolfenden was graduated from the University of Michigan, after which he spent several years in Detroit as consulting engineer, later going to Denver and engaging in engineering and contracting. He then became connected with the Allis-Chalmers Mfg. Co., Milwaukee.

M. F. Beetham has been appointed service inspector in the eastern district for the Whiting Corp., Harvey, Ill., succeeding C. H. Erickson who has resigned.

Interest Shown in Club at Seattle

Considerable interest is being shown in the Seattle Foundrymen's Club. This club was organized about a year ago to promote social intercourse and better personal acquaintance between owners and executives of the Seattle gray iron foundries. The officers of the club are as follows: President, J. E. NePage, president of NePage, Kenny & Co.; vice president, W. R. Tompkins, president of the N. & S. Foundry Co.; and secretary, Edward C. Gustin, Summer K. Prescott Co., Seattle.

Appointed Sales Manager

W. L. Sexton, formerly in the Chicago office of the P. H. & F. M. Roots Co., Connersville, Ind., and more recently in the company's offices at Connersville, has been appointed sales manager in charge of the Chicago office, succeeding J. B. Patterson, who has entered the Hopp-Patterson Co., Chicago.

Joins Sales Force

C. F. Copp recently has become connected with the sales department of the W. W. Sly Mfg. Co., Cleveland. He formerly was in charge planning and executing engineering work at the Cleveland plant of the National Carbon Co.

A Correction

In the article entitled "Making Large Strainer Cover Molds" appearing in the Aug. 1 issue of THE FOUNDRY, the illustration on page 605 should have been Fig. 5 instead of Fig. 6.

Opens Cleveland Office

The Cleveland office of the Pangborn Corp., Hagerstown, Md., now is located at 622 Penton building. John C. Pangborn, vice president, is in charge assisted by F. E. Wolf.

Sails for Europe

Dexter A. Tutein, in charge of the Philadelphia office of E. Arthur Tutein, Inc., sailed for Glasgow, July 26, for two months visit to Europe.

Plant Is Purchased

The French Creek Foundry, Franklin, Pa., has been purchased by the Franklin Valve Engine Co., to replace its foundry which was badly damaged by fire May 23. It was understood at the time that the loss amounted to $125,000.

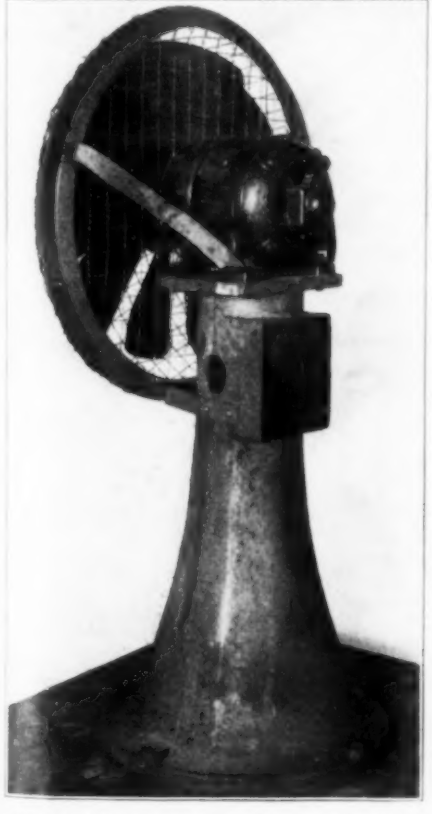
Designs Cooling Fan

A new fan introduced by the Buffalo Forge Co., Buffalo, is applicable to foundries as a means of supplying better conditions for the worker. This unit is made in two sizes, the larger having a fan wheel 36 inches in diameter and the smaller a 30-inch wheel. The entire fan is of heavy construction to prevent vibration; the screen enclosing the fan wheel is heavy, while the rim is made of an 2¼ x 2¼-inch angle. However, the unit may be moved easily about the plant to be directed on men working in proximity to heat sources such as furnaces, hot molds, core ovens, etc.

This type of fan, shown in the accompanying illustration, consists of three parts, namely the fan wheel, a direct connected motor and the pedestal. The larger fan has a 5 horsepower motor while the smaller fan has a 3 horsepower unit. The speed of both fans is 900 revolutions per minute. The pedestal is a heavy casting and four bosses are provided in the base for foundation bolts.

Makes Grease Cup

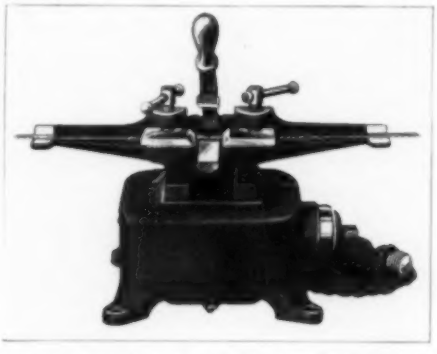
The Link-Belt Co., Indianapolis, has developed a new top for its regular compression grease cup. This cup is hexagonal in shape, providing a good grip for hand or wrench. Cold, stiff grease makes a compression cup turn hard and a pipe wrench always is not accessible. The hexagonal shape provides grip spaces for the ordinary wrench. The cup also has a raised slot so that the cup may be turned with a screw driver when inconvenient to turn with a hand wrench.



ELECTRIC FAN SUITABLE FOR FOUNDRY USE IS BUILT IN TWO SIZES

Brazes Band Saws

The Oliver Machinery Co., Grand Rapids, Mich., has developed a new device for brazing band saws. The device includes a transformer, of which the main coil is connected to a power plant through a switch, and a secondary coil which serves as a stay for both saw ends. A hand operated center clamp holds the ends to be brazed firmly together for several seconds after the brasing metal has been melted down.

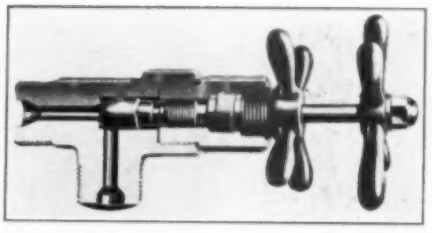


OPERATION OF BRAZER IS SIMPLE

The operation of the device is simple, it is claimed. The laps are beveled and prepared in the ordinary way and the ends of the saw placed in position in the self aligning clamps with the beveled ends overlapping under the center clamp. A small strip of solder is placed between the beveled surfaces and the borax flux applied. When the brazing metal is melted, the current is turned off and the center clamp tightened. The device will braze band saw blades 19 gage or thinner up to a 1¼-inch width.

Valve for High Pressure

A valve for oxygen manifolds designed to withstand high pressures recently has been introduced by the Oxweld Acetylene Co., New York. The new valve has a swivel tip on the stem. The cross sectional illustration shows the details of its construction and operation. The body has a formed seat receiving the stem tip. This tip is attached to the stem by a swivel joint, thus enabling the tip to seek its natural seat in the body. The stem screw is in the inner end of the stuffing box which is made gas tight by a lead gasket. The stem is made gas tight by rubber packing which is compressed between packing rings by a hand wheel and a nut. If the operator screws the hand wheel all of the way out, the internal parts will not be blown out by pressure because the stem screws into the stuffing box.



SAFETY FEATURES INCLUDED IN THE DESIGN

Offices Are Moved

The Robert June Engineering Management Corp., Detroit, which handles industrial advertising, sales development and engineering management, is moving from the present address at 8938 Linwood avenue to 8835 Linwood avenue.

Building New Plant

The Carbon Steel Casting Co., Lancaster, Pa., is building a large new foundry at that place. Frank Chase, Chicago, is the engineer.

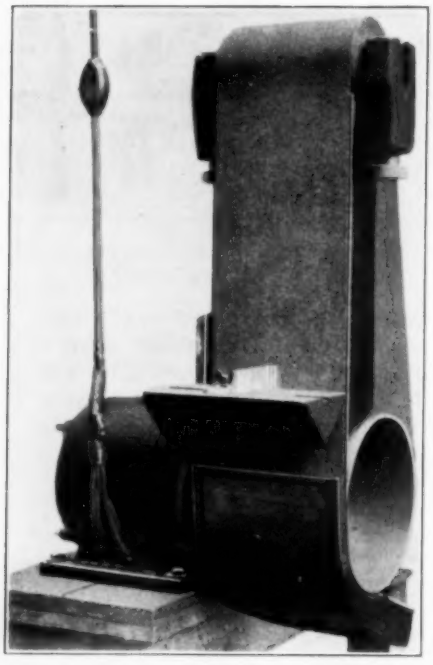
Obituary

Richard Harrison, manager of the Framingham, Mass., foundries of the B. F. Sturtevant Co., Hyde Park, Mass., died July 16 at Boston.

Harold Colbert Jones, for many years vice president and director of the Inland Steel Co., and more recently president of the Midwest Forging Co., Chicago, died July 18. Mr. Jones was a son of G. H. Jones, president of the Hillside Fluor Spar mines, Chicago, and a director of the Inland Steel Co.

August Schwenn, president of the H. P. Deuscher Co., Hamilton, O., operator of a gray iron foundry doing a general jobbing business, died July 16 at Hollywood, Cal. Mr. Schwenn became ill several months ago of heart disease and went to California for his health. He had been president of the H. P. Deuscher Co. since 1913. He was interested also in several other industrial enterprises.

A layer of sand insulates the brick molding floor against incidental hazard from molten metal, and the sand easily can be collected and replaced when its periodical recovery treatment for valuable content becomes necessary.



THE SANDER IS DRIVEN WITH A ½-HORSEPOWER MOTOR

Belt Sander May Be Used in Two Positions

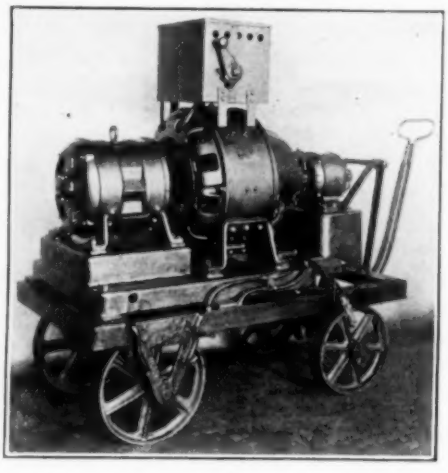
A small belt sander and grinder with a grinding bed of 18 x 18 inches recently has been introduced by the Porter-Cable Machine Co., Syracuse, N. Y. The Machine is made convenient for numerous operations by using the grinding bed in either the vertical or horizontal positions.

The machine is driven by a ½-horsepower motor directly connected to a 7½-inch drive pulley. The diameter of the idler pulley is 4 inches. Adjusting screws are placed along the side of the frame and are not in the way when the belt is being changed. The table, which is equipped with an angle gage, is removable for work requiring the full use of the grinding bed. The dust hood also may be removed easily. The machine is adapted to bench work or may be used with a portable pedestal for work scattered about the shop. The abrasive belt is 6 x 54 inches which runs at a speed of 3300 feet per minute. The table is 4 x 7 inches and tilts 45 degrees up and 15 degrees down.

Arc Welding Equipment Is Portable

The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has designed a compact, entirely self contained, single-operated, 200 ampere, arc welding apparatus, which is available in either the stationary or portable form. The generator will deliver 300 amperes on intermittent work and any welding current from 60 to 300 amperes may be obtained through the rheostat located outside the control cabinet. Close current regulation is possible through the 61 steps on the rheostat.

If an extremely high current is desired, the generators of several machines may be operated in parallel. Any of the commercial sizes of metallic electrodes from 1/16 to ¼ inch may be used. The generator and driving motor are mounted on a common shaft to which the exciter is coupled by a special coupling. Either an alternating current or a direct current motor may be supplied. Alternating current motors may use either 220 or 440 volt supply circuits by rearranging the lead connections. If desired, an ammeter and voltmeter are mounted on the cabinet where they may be observed by the operator while adjusting the rheostat for current control. The truck is heavily constructed and equipped with roller bearings.

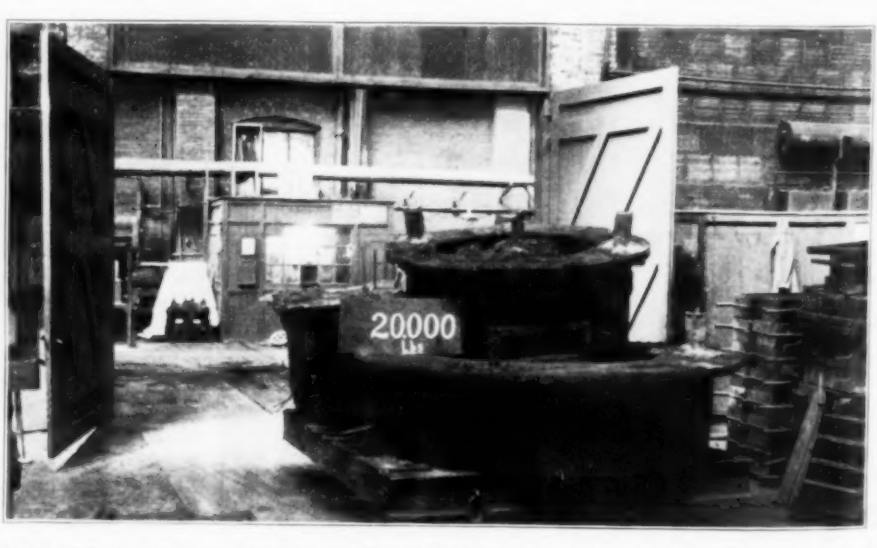


GENERATOR DELIVERS 300 AMPERES ON INTERMITTENT WORK

Pneumatic Hoist Handles Foundry Materials

The accompanying illustration shows a pneumatic hoist made by the Sullivan Machinery Co., Chicago, which is used to pull a car loaded with rough castings from the molding floor to the cleaning rooms at the foundry of that company in Claremont, N. H. This hoist is made in either the single or double drum type, the one shown having a double drum. However, in this case the hoist is used to move the car only in one direction to avoid any obstruction on the floor at the opposite side. The movement of the car from the cleaning room to the molding room floor is accomplished by an electric shop truck, as the car is empty on the return trip and light enough to be handled easily by the truck. The hoist also is used in the Sullivan plant to carry large buckets of sand from a sand mixed to a position where they may be picked up conveniently by the crane, and to spot railroad cars in the shipping department and in the sand receiving department.

The double drum hoist weighs 555 pounds, or about 85 pounds per horsepower, is 29 inches long, 15 inches wide and stands 19 inches high. The motor in its casing is supported on a central standard with a broad frame or foot and supplies power to the two hoisting drums, each 11⅛ inches in diameter with a 5⅛-inch face. Each drum holds 225 feet of 5/16-inch wire rope. A driving pinion at each end of the motor casting engages an internal gear in each drum shell. The capacity of both single and double drum hoists are the same, namely a load of 2000 pounds may be lifted vertically at a speed of 110 feet per minute with 75 pounds air pressure. Sufficient air may be supplied through a ¾-inch hose to develop its rating of 6½ horsepower.



CAR OF LARGE CASTINGS IS TRANSPORTED FROM THE MOLDING FLOOR TO THE CLEANING ROOM BY PNEUMATIC HOIST

Market Tone Slightly Better

Increase in Foundry Operations Causes Feeling That Business Conditions in the Equipment Field Will Improve Soon—Report of Census Bureau Shows May Sales Fell Below the April Total

SENTIMENT in the foundry equipment market in the leading distribution centers continues to show signs of improvement. This may be attributed to the slight increase in the volume of sales of machinery and also to the fact that a betterment in foundry operations now is in evidence. Manufacturers believe that the pickup will continue and that action soon will be taken on many of the inquiries that have been held up for some time. Inquiries now are being brought out at about the same rate as previously reported. Sales of foundry supplies continue fair although price cutting is reported in several lines.

May shipments of foundry equipment, which have been announced by the United States bureau of census, showed a value of $390,161. This was a drop from the April total of $476,206 and the May 1923 figure of $453,861. The value of equipment sold during the month of May was $314,214, as compared with $469,478 in April. The value of unfilled orders for foundry equipment in June 1 was $575,161, representing a gain over the total on May 1, which was $573,858, but being below the total for the corresponding date last year which was $698,165.

The W. P. Dowling Brass Foundry Co., 547 Bay street, East, Savannah, Ga., is in the market for a machine for making soil pipe.

Equipment Sales Are Reported Heavier

SALES of foundry equipment in the Cleveland territory are at about the same level as was reported two weeks ago. Inquiries have maintained almost the same rate, and in a few cases users of machines again are considering inquiries which have been pending for some time. Several manufacturers have their plants running at almost normal capacity, while others have not been benefited sufficiently by the slight betterment in business to increase plant operations. However, pattern shops in this territory are working practically at capacity, and a slight increase is reported in foundry operations, which is leading manufacturers of equipment to feel that good business is not far off. Repair business continues at a good rate as foundries prepare for heavier operation schedules.

The Mayor Fuel Saving Furnace Co., Cleveland, has sold a core oven furnace to the Youngstown Foundry & Machine Co., Youngstown, O. Sales of the Pangborn Corp., Hagerstown, Md., include sand-blast and dust arrester equipment to the Canadian Westinghouse Co., Ltd., Hamilton, Ont., and sand-blast equipment to the National Castings, Ltd., Belleville, Ont. A sand drying machine has been sold to the Jewell Steel & Malleable Co., San Francisco. The same company has sold sand blast equipment to the Humphreys Mfg. Co., Mansfield, O., and dust arrester equipment to the Kirk-Latty Mfg. Co., Cleveland.

The B. C. Valve Co., Ltd., 513 Standard Bank building, Vancouver, B. C., is preparing plans for equipment for their foundry. The company desires information concerning electric furnaces for nonferrous alloys. The United Carborundum & Electric Works Co., Stare Benathy, Czechoslovakia, is interested in special wood working machinery.

Sentiment Is Better

WHILE sales of foundry equipment are far from active, the sentiment throughout the trade in New England has improved decidedly and equipment dealers are more hopeful now than they have been in many weeks. Recent sales include four or five sand cutting machines, a crane, some oven equipment, and perhaps six or eight molding machines. The American Chain Co. bought several molding machines and considerable other equipment for its foundry at Hartford, Conn. The Westinghouse Electric & Mfg. Co. has purchased molding machines, flasks, and miscellaneous items for its Springfield, Mass., foundry.

Pittsburgh Keeps Pace

FOUNDRY equipment sales in the Pittsburgh area are more or less commensurate with foundry operations. These with but few exceptions are low, the foundry business in general being dull. A fair number of inquiries are before the trade, but these are mostly of long standing, practically no new ones coming out lately. A Toledo, O., foundry which has been inquiring for a large core oven, 6 feet wide, 8 feet high and 12 feet deep, complete with lift trucks, oil burners, exhaust equipment, etc., still defers action. The Pittsburgh Gray Iron Foundry, Inc., Pittsburgh now is installing the core oven it bought recently, together with other equipment. Several cupola inquiries still are hanging fire including one from the Standard Sanitary Mfg. Co., Pittsburgh. A foundry on the Monongahela river bought an embossing machine for pattern letters from a Pittsburgh dealer which also sold a magnetic separator to the John F. Byers Machine Co., Ravenna, O. One or two nearby foundries bought molding machines recently but several from more distant points still are negotiating. The Pangborn Corp., Hagerstown, Md., has sold sand blast equipment to the American Bridge Co., Pittsburgh, and the International Harvester Co., Auburn, N. Y. The demand for blacking, core compound, facings, shovels, riddles, wheelbarrows and kindred small equipment is more or less steady but this month's total sales probably will be lower than July's. The Center Machine & Foundry Co., South Warwood, W. Va., is in the market for machine shop and foundry equipment for some new buildings. The J. P. Ward Foundry Co., Blomsburg, Pa., is inquiring for foundry equipment for the manufacture of pipe fittings, J. E. Willis being the purchasing agent. O. Roy, La Prairie, Que., sent in an inquiry recently for foundry equipment, including furnaces, etc. The Pratt & Letchworth Co. Buffalo is buying machinery for powdering and crushing coal which will be installed in a new addition to its foundry. The Shilling Foundry Co., Columbus, O., wants metal working machinery and equipment. The Kelly Foundry Co., Pittsburgh, recently was incorporated to operate a foundry, pattern shop and machinery shop and may need equipment. The Flynn-Wolff Bronze Foundry Co., Swissvale, Pa., also a new incorporation

may issue a list of equipment shortly. The American Steel Foundries, Sharon, Pa., is remodeling buildings which have been closed for five years and is understood to be needing some equipment.

In the crane market, foundry inquiries are rare. The Westinghouse Electric & Mfg. Co., awarded a 10-ton, 4-motor, 48-foot span electric traveling crane for Trafford City, Pa., to the Morgan Engineering Co., Alliance, O., but has not as yet bought its wall crane for Sharon, Pa. The Westinghouse Airbrake Co., Wilmerding, Pa., still is in the market for five, 5-ton one, 3-ton crane and 5 hoists.

Slight Improvement Seen

THE foundry indutsry in the Chicago district is evidencing some signs of improvement and without doubt the trend is upward, but this improvement is spotty. This condition is reflected in foundry equipment lines. The National Engineering Co. has placed its sand mixers in the foundries of the American Malleable Castings Co., Marion, O., the Hunt-Spiller Mfg. Co., Boston, and the Greenlee Foundry Co., Chicago. A sand blast room and dust arrester equipment has been purchased by the Bucks Stove & Range Co., St. Louis, from the W. W. Sly Mfg. Co., Cleveland. The Sly company also has sold special burnishing mill equipment to the Vollrath Co., Sheboygan, Wis. and cinder mill equipment to the Red Jacket Mfg. Co., Davenport, Ia. The Pangborn Corp., Hagerstown, Md., has sold sand-blast equipment to the Stromberg Motor Devices Co., Chicago.

Inquiries Quicker in The East

A DECIDED improvement is reflected in the demand for foundry supplies throughout the New York territory. This buying is due to more active production in the foundries. A more cheerful feeling prevails than in some months past due to the expectation of a continuance of the improvement. Demand for foundry equipment also shows an improvement, but this is not so marked as in the case of foundry supplies. However, it is believed that the next month or two will show much more business in foundry equipment than has been in evidence for several months.

In the equipment market, demand for sand-blast installations and sand cutting and handling apparatus shows most activity. The Boynton Furnace Co., Jersey City, N. J., has placed a sand cutter. An order for a sand cutter has come from the Weil-McLain Co., Michigan City, Ind. One of the most important inquiries now out involves molding machines and other equipment for the Maryland state penitentiary at Baltimore. The Carbon Steel Casting Co., Lancaster, Pa., is in the market for some equipment for its new plant. The Reading Hardware Co., Reading, Pa., also will buy shortly for a new plant. The American Radiator Co. is in the market for some units for its Buffalo foundry. The Burnham Boiler Corp., has bought some equipment for its new shop at Lancaster, Pa. Makers of pneumatic equipment report that demand from the foundry trade is dull. Several electric furnace inquiries are under negotiation, but no sales have been reported recently.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

Owego Bridge & Iron Co., Owego, N. Y., is inquiring for additional equipment for its foundry.

Motor Car & Truck Co., Huntington, W. Va., has awarded contracts for constructing a 3-story, 105 x 200-foot foundry.

American Steel Foundries, Sharon, Pa., is reported repairing its works which have been closed for the past five years.

Western Pacific railroad is planning roundhouse, shops, machine shops, etc., at Poplar and Sacramento streets, Stockton, Cal.

O. Roy, LaPrairie, Que., is reported as being in the market for machinery for a foundry, including furnaces, etc.

The Indianapolis Electric Steel Casting Co., Indianapolis, has been incorporated with 500 shares no par value stock, by Herman, Robert and Sarah L. Lifchitz.

Acme Foundry & Machine Co., Coffeyville, Kans., operator of gray iron, brass and aluminum foundries, is in the market for steam indicators and electrical testing instruments.

DeMattia Foundry & Machine Co., 6 Monroe street, Clifton, N. J., has been incorporated for $1,000,000 to manufacture iron and steel metal products.

American Car & Foundry Co. plant at Metcalf and Fleming streets, Buffalo, N. Y., was damaged recently when struck by lightning.

Center Machine & Foundry Co., South Warwood, W. Va., is reported as increasing its plant facilities through construction of a building addition.

Pacific Cast Iron Pipe & Foundry Co., Los Angeles, has been incorporated with $300,000 capital stock to make iron and other metallic castings, pipe and other products, by R. P. Drummond, C. R. Gallagher and J. A. Dunn as incorporators. E. C. Rivenius, Pasadena, Cal., is representing the company until further organization is affected.

Flynn-Wolff Bronze Foundry, Swissvale, Pa., has been incorporated for $1500 by J. E. Flynn, Philadelphia, M. J. Flynn, Swissvale and Ervin A. Wolff, Pittsburgh.

Schilling Foundry Co., Poplar and Henry streets, Columbus, O., is reported as being in the market for metalworking machinery and equipment.

E. A. Julien, 208 Grand avenue, Wauwatosa, Wis., has awarded construction contracts for a 1-story, 50 x 100-foot brass foundry and machine shop at 1642 Holton street, Milwaukee.

The Pacific Stove & Foundry Co., 1102 Idaho street, Seattle, has awarded contracts for constructing a 1-story foundry addition, to W. J. Symonds, 4568 Thirteenth street, that city.

Ward Railway Appliance Co., Lima, O., has leased the plant of the Bernhard Boiler Co. and will equip it to manufacture heavy locomotive and marine castings. Joseph T. Ward is president.

Kelly Foundry Co., Pittsburgh, has been incorporated with $50,000 capital, to operate foundries, pattern shops, machine shops, etc., by James G. Kelly, Nicholas J. Kelly and Stella Kelly, Mt. Oliver, Pa.

Ross-Meehan Foundries, Carter street, Chattanooga, Tenn., is reported as contemplating constructing a 1-story foundry, 120 x 200 feet. The company operates gray iron, malleable, steel, brass and aluminum foundries.

Pratt & Letchworth Co., 189 Tonawanda street, Buffalo, N. Y., malleable and steel foundry operator, and manufacturer of locomotive castings, plans construction of a $40,000 addition to its foundry. The plant will be of concrete and steel, 2-stories high and will house machinery and equipment for powdering and crushing coal.

A. W. Kousek plans establishment of a gray iron and semisteel foundry at Melvin avenue and Northwestern tracks, Racine, Wis. Mr. Kousek formerly was with the Standard Foundry Co., that city, which he formed and sold to other interest several years ago.

Phoenix Machinery Mfg. & Foundry Co., Inc., Mobile, Ala., has been incorporated with $250,000 capital, to conduct a general machinery and foundry business by V. P. McVoy, C. C. Constantine and J. F. LeBlanc as incorporators.

The Gartshore-Thomson Pipe & Foundry Co., Ltd., Hamilton, Ont., has been incorporated with $1,000,000 capital stock, to carry on the business as iron founder, iron master, steel founder, converter, etc., by William S. Morlock, Sydney E. Wedd, John G. Middleton and others of Toronto, Ont., as provisional directors.

A. F. Corner, James Wisdom and O. W. Bottorff have installed a brass and aluminum foundry at 815 Spring street rear, Coffeyville, Kans. The new company will mnaufacture aluminum and brass castings and do a general foundry business. A. F. Corner formerly was superintendent of the pattern department of the Acme Foundry & Machine Co., that city.

The Agate Foundries, Inc., 17215 Park avenue, Chicago, has been incorporated to manufacture and deal in iron, steel, brass and aluminum. The company was formed with $25,000 capital. J. B. Brownlee, Paul Wachel and D. H. Brownlee are incorporators and John G. MacDonald, 1200 West Minster building, is correspondent.